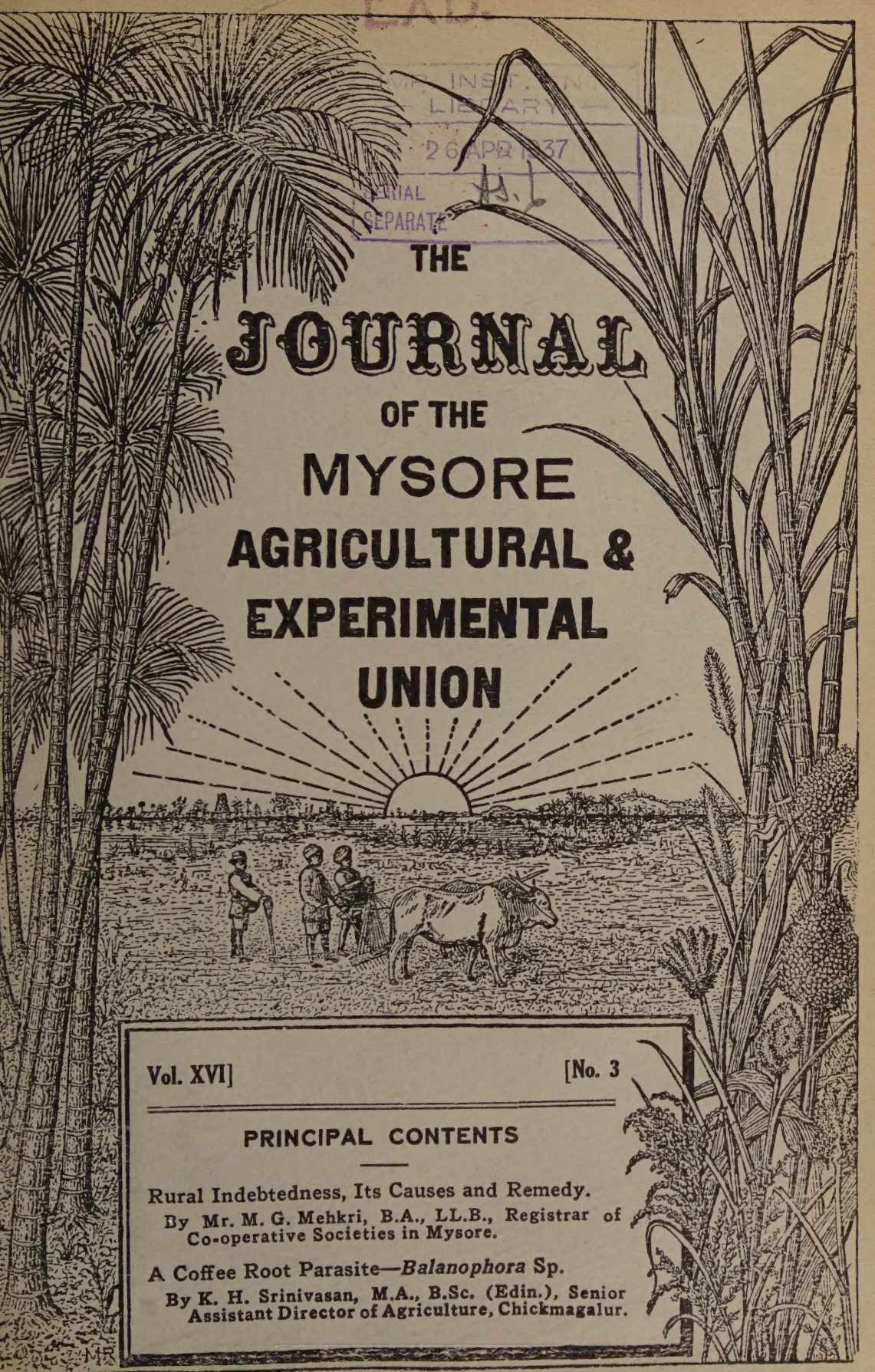
INST. OF AGRIC.
LIBRARY
26 APR 1937
INITIAL
SEPARATE

# THE JOURNAL OF THE MYSORE AGRICULTURAL & EXPERIMENTAL UNION



Vol. XVI] [No. 3

## PRINCIPAL CONTENTS

Rural Indebtedness, Its Causes and Remedy.
By Mr. M. G. Mehkri, B.A., LL.B., Registrar of Co-operative Societies in Mysore.

A Coffee Root Parasite—*Balanophora* Sp.
By K. H. Srinivasan, M.A., B.Sc. (Edin.), Senior Assistant Director of Agriculture, Chickmagalur.

GUARANTEED ANALYSIS

LOWEST PRICES

# FERTILISERS

## The Hall Mark of Quality

*We supply Fertiliser Mixtures suitable for :*

Paddy, Sugarcane, Plantains, *Ragi*, Coffee, Cocoanuts, Tea, Arecanuts, Onions, Potatoes, Etc.

also

Straight Fertilisers, such as Sulphate of Ammonia, Superphosphates, Concentrated-Superphosphate, Sulphate of Potash, Muriate of Potash, Nitrate of Potash, Bone-Meal and Compound Fertilisers, Etc.

*For Further particulars re : prices, etc. apply to :*

**THE MYSORE FERTILISER Co.**

**Chamarajapet, BANGALORE CITY**

**or 124, Angappa Naick St., MADRAS**

TO IMPROVE AGRICULTURE

READ THE

# Madras Agricultural Journal

*Published Monthly*

Annual Subscription, including postage, Rs. 4—0—0

Specimen Copies on request.

*Apply to*—**The Manager, Madras Agricultural Journal,**

**Lawley Road P.O., COIMBATORE.**

The Journal
of the
Mysore Agricultural
and
Experimental Union

Vol. XVI] [No. 3

# Rural Indebtedness, Its Causes and Remedies

## A Free Translation of the Kannada Version of a Radio Talk

By

**Mr. M. G. Mehkri, B.A., LL.B.**

*Registrar of Co-operative Societies in Mysore*

The subject of my talk to-day is to explain to you in as brief a manner as possible what the causes for the indebtedness of our ryots are and how far the co-operative movement can render them some relief.

Among the many important causes for rural indebtedness, I will refer to a few.

1. From the Census Report for 1931, it is seen that there has been an increase of 9% in the population of Mysore in the course of the last decade preceding 1931; but the extent of land brought under cultivation has not increased in proportion to the increase in population. Most of the lands easily accessible and suitable for farming have long been under cultivation and the available extent is also slowly being brought under the plough. The irrigation scheme under the Krishnarajasagara has rendered it possible for the hitherto uncultivated lands being brought under irrigation. Still, the total agricultural produce from all lands under cultivation is not

sufficient to meet the wants of our population. Many ryots still feel the pinch of poverty and have hardly a meal a day. This necessarily leads them to borrow further. As they inherit more ancestral debts than property, they continue to groan under the burden of heavy debt and being unable to pay even the interest, due every year, they sink further in debt.

2. Agriculture has not been a paying industry of late, especially under the present economic conditions. While the return from land is just enough to keep the ryot going, it does not enable him to discharge his debts. Being driven to live in ill-ventilated dwellings, on food which is not nourishing and ill-clothed to withstand the effects of climate, his energy is sapped by sickness. The ryot is content with his lot and ascribing it to his fate he resigns himself to a low standard of living, has very little enthusiasm to live well by earning more.

3. A glance at the season and crop reports will show that there is fluctuation in rainfall and consequently the yield of crops varies from year to year. During a period of every five years, it is observed that the crops in 3 years are normal and in one year the ryot gets a bumper crop and the fifth year a bad harvest. On the whole, taking the average, he gets not more than what would suffice for his and his family maintenance and payment of assessment to Government, when the price of food-stuffs has gone down as at present. He is a wise ryot who in years of plenty would save some money to pay off his debts. But such cases are very few. During years when crops are good and the prices fetched are high, the extra income is squandered away by the ryot on marriages and ceremonies. In some cases a prudent ryot invests it on the purchase of cattle, necessary for his farming. So the burden of debt continues from generation to generation. The late War brought the ryot very good price for his produce. He suddenly grew rich. Instead of utilising this extra income to redeem himself, he cultivated a standard of living, which was rather difficult for him to give up when his income was

reduced. By this, it is not meant that he should not improve in his standard of living, but what is suggested here is that he should not have cultivated habits and tastes which were beyond his means.

4. Factions in the villages are another potent cause for rural poverty. Much time and money is spent on litigation. Cases have been fought out both on the criminal and civil side up to the highest tribunal, and people do not hesitate to borrow for this wasteful purpose, thus adding to their already existing heavy debts.

5. Our ryot has no work, on an average, for six months in the year. Instead of utilising this spare time in some subsidiary occupation, to increase his earnings, such as poultry farming, bee-keeping, dairy farming, weaving, reeling silk, etc., he wastes it in idle gossip on the pial of his house or that of another, or attending courts.

6. Much money is spent on marriages and ceremonies. There is much avoidable waste on these occasions. When a person has no means to repay his old debts he contracts more to celebrate them, as he considers it a religious duty. What is an hour's pleasure will be a life-long misery thereafter.

7. Laws of inheritance are also a great handicap to our ryots. Sons, and under the present law even daughters, have a claim in the property. This has led to sub-division and fragmentation of properties and consequently less income due to small bits not being cultivated.

8. Cattle mortality due to sickness among animals and ravages of wild beasts, particularly in the Malnad, is another source for increase in the indebtedness of the ryot. He has to borrow funds to replace them, if he is to cultivate his lands.

9. *Sahukars* in a village are a necessity to meet the urgent needs of the ryots, as they cannot borrow from Joint-Stock banks which are far away from their villages. Credit is facile but not cheap. The *Sahukar* will be satisfied if he

recovers interest every year and would leave the principal with the debtor indefinitely. If no interest is paid, he will take care to have a fresh bond for the consolidated sum till he feels the security is inadequate or he could snatch away the land from his debtor. While farming does not give a ryot more than 4% by way of return, he agrees to pay interest ranging from 12 to 30%. It is impossible for him to meet even the interest charges. He will have either to surrender the land or sell it to repay the *Sahukar*. He not only thereby loses his land, and with it his living, but causes a decrease in the wealth of the State by such transfer to absentee landlords or to persons who do not cultivate the lands themselves.

These are some of the chief causes for rural indebtedness in India. I will now mention some of the remedies:—

(1) Government have launched upon large irrigation schemes and have brought lands which were uncultivable under wet cultivation. Ryots have been encouraged to grow commercial crops like sugarcane.

(2) Establishment of factories, partly by capital subscribed by Government and partly by the public, has enabled people to find a market for their produce. The Sugar Factory at Mandya is an example of it.

(3) Facilities have been given to grow tobacco, groundnut, cocoanuts, areca and coffee and arrangements have been made to find suitable markets for them.

(4) The establishment of the Paper Factory, Spun Silk Factory, etc., will not only give employment to people needing it, but will also encourage subsidiary industries like mulberry growing, rearing silk-worms, etc.

(5) Rural Centres are being established with grant-in-aid from Government to teach the villagers round about the Centre how to rear poultry, keep bees for producing honey and other subsidiary occupations.

(6) A Sub-Committee had been appointed to suggest measures for preventing sub-division and fragmentation of holdings. The Committee have reported that there is not

much sub-division in our State and the problem not very acute. Still, it is thought that propaganda should be done to prevent it in future and to consolidate holdings in a few selected villages.

(7) To prevent cattle mortality, Veterinary Hospitals have been established in all Taluk headquarters. Various diseases to which cattle are subject have been prevented by inoculation. A Serum Institute has been started which supplies the whole quantity of serum required by these hospitals. Death-rate among cattle has been considerably reduced.

(8) Our Agricultural Department, which is stated to be one of the best in India, is supplying selected seeds and manures to the farmers to increase the yield and to fetch better prices for their produce. Improved implements are supplied to ryots for better cultivation of land.

(9) To save the indebted ryot from paying unconscionable rates of interest, Government have passed the Usurious Loan Regulation which enables him to call for a statement of account and the court to reduce the rate of interest if it is exhorbitant. The Agriculturists Relief Regulation, while allowing a scrutiny of loan accounts, fixes the period of repayment by a ryot whose income is below Rs. 500 to eight years. Government have just got through the Legislative Council the Debt Conciliation Bill on a voluntary basis to conciliate all debts.

The above are the measures adopted by Government to help the ryot.

Whatever Government may do, the initiation must come from within. Unless the people themselves change their mode of life, habits, there is no salvation for them. Expenditure on marriages and ceremonies should be curtailed, all avoidable waste prevented, and luxuries, which cannot be purchased within one's means, should be eschewed.

Co-operative Societies, established in the State, teach their members the habit of thrift by encouraging them to go in for shares and provident fund bonds and to deposit their

savings. Loans are given at low rates of interest and their punctual repayment is insisted upon. As loans are to be given for productive purposes only, the amounts cannot be frittered away on wasteful items. When loans cannot be repaid out of the produce of the same year or the next year, such as loans for purchase of cattle, construction of irrigation wells or improvement of lands, which require a heavier outlay, those members can get the amount through their societies from the Apex Bank, repayable in 10 years. Where larger amounts are required for discharging prior debts repayable in a still longer period, Government have established a Land Mortgage Bank for lending amounts to such persons. People having debts ranging from Rs. 500 to Rs. 5,000 can get assistance from this Bank.

I will illustrate the advantages of such a Land Mortgage Bank.

Suppose a ryot borrows Rs. 500 from his society at the generally prevailing rate of 9%, he will have to pay towards interest alone Rs. 45 every year and yet the principal of Rs. 500 will be due. If, on the other hand, he goes on paying Rs. 46–14 every year for 25 years, he will have paid back both principal and interest. This is when the Bank is charging 8% interest through societies. If its rate is reduced further, say to 6%, the instalments will be easier and less in amount.

Loan and Sale Co-operative Societies will have to be established wherever Land Mortgage Societies have been started. These will enable the ryots to borrow from the societies sums for their current agricultural needs. Their produce could be stored in the godowns of the societies and about 75% of the value of the stock stored in the godown may be advanced to the member for meeting his other requirements and the produce sold in favourable markets when prices are high. These societies will enable the ryot to get more money for his produce and eliminate the profits of the middlemen.

Similar societies for the benefit of sericulturists and

weavers have been started. Formation of better living societies and societies for labourers are under active contemplation. By these means, it is intended to increase the earning power of the ryot and thereby to reduce his indebtedness. It is now his duty to realise his position and to help himself by prudent economy on one side and increase of earning power on the other.

---

## A Coffee Root Parasite—*Balanophora* Sp.

By

**K. H. Srinivasan, M.A., B.Sc. (Edin.)**

*Senior Assistant Director of Agriculture, Chickmagalur.*

### Introductory

It is well known that *Arabica Coffee* in Mysore is subject to various diseases and pests but the existence of a flowering plant parasitising the roots of coffee trees may not be known to many people. Old and experienced planters knew this flowering plant parasite on the roots of coffee trees but were ignorant as to its mode of growth and relationship with coffee trees and generally were under the impression that the parasite was like one of the several harmless fungi (Anabes) that commonly grow in almost all coffee estates. Hence, its eradication was not attempted. The writer came across the parasite for the first time in 1930 when he was on a visit to a coffee estate near Merthi. Specimens were collected and during the Field Day at the Government Coffee Experimental Station at Balehonnur, in November 1931, several tubers of the parasite with well-developed flower heads were exhibited and the planters acquainted with the parasite and with the measures for its control.

### Distribution

The parasite is a species of *Balanophora* belonging to the well-known family of flowering root parasites—*Balanophoraceæ*. It is found in coffee estates near Kalasa, Koppa

and in other parts of the Bababudan Hills in the Mysore State. It occurs at elevations of 3,500 to 4,000 feet and upwards, and appears to thrive well at the higher altitudes.

Although the distribution of the parasite is fairly wide, its infection is localised. It is seldom seen to infect many estates in the same locality. Even in a single estate, its distribution is restricted to isolated patches. Apart from coffee, the parasite is found associated with the roots of some of the shade trees and those of a few jungle trees.

## General Description

The parasite occurs in the form of a rootstock composed of tuberous outgrowths on the lateral roots of coffee trees and makes its appearance during the middle of the South-West monsoon. In the early stages of development, the tuberous outgrowths are small roundish bodies hidden inside the soil. Towards the close of the South-West monsoon, the growth of the tubers becomes pronounced and they begin to appear above ground. They are more or less round, resembling potato tubers in shape and having a pale brown colour. As they mature, the tubers increase in size and have numerous branched outgrowths. Flower heads begin to appear about November. A well-developed tuber with its flower heads weighs three to four pounds or even more. The male and the female flower heads grow on different tubers usually far removed from one another.

## Female Flower Heads

The female flower head has a stalk—the peduncle, which terminates in a round head. The numerous minute female flowers are embedded in the round head. The flowers are so minute and packed so close to each other that it is hardly possible to distinguish them with the unaided eye. The entire flower head looks like an unopened toad-stool having a chocolate colour. (Photo plate shows the different flower heads and part of coffee root to which they are attached.)

### Male Flower Heads

The male flower heads are borne on different tubers in the same manner as the female flower heads and are usually far removed from the latter. When mature, the male flower head assumes a slightly conical shape studded with numerous male flowers. The mature pollen on the anther-sacs looks like a white mealy or cottony cushion. (See Plate—Male flower, old.)

### Mode of Growth

The flower heads begin to appear about November and generally the flowers are ready for pollination in about two months. From the nature of the mealy pollen, insects seem to be necessary agents for the transference of pollen from male flowers on to female flowers. At the end of February or beginning of March, the tubers with the flower heads begin to wilt and collapse, the seeds having ripened by then. By the time the South-West monsoon commences, an old tuber can seldom be seen. The ripe seeds fall on the ground and are carried away by rain or wind. The fact that each female flower head produces innumerable seeds restricts the chances for all of them to obtain favourable conditions for germination and growth. When many of them germinate, only a few seem to succeed in gaining access to the roots of their host.

### Mode of Nutrition

*Balanophora* is a leafless parasite and hence it depends on its host for the complete supply of its food. Dr. B. T. Narayanan, B.A., Ph.D., D.I.C., Senior Assistant Chemist of the Department of Agriculture, has subjected the tubers and flower heads of *Balanophora* species parasitising the roots of coffee trees to a thorough chemical analysis and has found out some interesting facts. A full discussion of his findings will be published shortly. In passing, it may be mentioned here that the tubers seem to contain a very high percentage of fat, 16.82%, and protein matter 11.625%, but a low percentage of starch, 4.0%. Thus, the transference of such a large amount of food material from the coffee trees to the

tubers of the parasite necessarily impairs the growth and affects the yield.

### Effect on the Host

The affected coffee trees do not show very clear external symptoms of ill-health. Careful scrutiny, however, will disclose differences in the colour of the foliage, the amount of vegetative growth, and in the crop produced between healthy and infected trees. There is a pronounced fall in the production of coffee in the infected trees and even a very generous treatment of them with cultural operations and manuring fails to bring about a satisfactory response. A coffee planter, in whose estate the parasite is found thriving well in about 40 acres furnishes some interesting facts. The parasite is growing in his estate for over 12 years and work on eradication by digging out has been taken up quite recently. It is common to find 5 tubers of the parasite per coffee tree and sometimes even as many as 10 to 12 tubers. He has dug out about 2¼ tons of tubers of the parasite in a five-acre plot and two tons in a nine-acre plot. He states that on account of this parasite, the yield of coffee decreases gradually, but he does not furnish any figures.

### Eradication

Fortunately, the eradication of the parasite is simple and easy. The tubers are so big as to be observed by the naked eye and can be easily dug out. The cost of digging out the tubers comes to within Rs. 5 per acre. One redeeming feature of the parasite is that it does not affect all the coffee trees in a plot but occurs here and there in patches or on individual trees. The tubers have to be dug out before the seeds mature. If they are left till the flower heads produce ripe seeds, they should be dug out and burnt to destroy the seeds. Generally, the tubers are observed above ground after November and their destruction must be completed before the seeds begin to ripen. In estates where the parasite has made its appearance, it is advisable to set apart a few coolies specially for this work and they should be instructed to go to each plot in search of the tubers. The incidence of the parasite

A. Female flowers fully developed. B. Male flowers fully developed with mealy pollen.
C. Male flowers showing mature and immature ones.

Pomegranates for sale at Madhugiri.

can be minimised and the parasite altogether got rid of in 2 to 3 years if work on eradication is carried out systematically.

SUMMARY

The parasite, a species of *Balanophora* belonging to the family of root parasites, *Balanophoraceæ*, is found on the roots of coffee trees.

The distribution of the parasite is fairly wide, but its infection in any one place is localised. It appears to thrive well on higher altitudes. Shade and jungle trees also act as host plants.

The parasite depends on its host for the complete supply of its food and hence, the producing capacity of coffee trees infected by the parasite is greatly impaired.

The eradication of the parasite is simple and cheap.

---

## Pomegranate Cultivation in Madhugiri

BY

**H. Padmanabha Rao, L.Ag.,** *Agricultural Inspector*

*General.*—Madhugiri is a taluk town in Tumkur District (Mysore State), about 27 miles east of Tumkur or about 48 miles to the north of Bangalore. It is a hilly country studded with rocky eminences. The valleys are sandy with plenty of springs. The climate is hot in summer. The average rainfall is 23.51 inches per year, 16.31 inches falling between April and September, *i.e.*, South-West moonsoon, and 7.20 inches falling between October and March, *i.e.*, North-East monsoon. The following table shows the monthly rainfall in inches for the recent few years:—

| Year | January | February | March | April | May | June | July |
|---|---|---|---|---|---|---|---|
| 1931 | .. | .. | .. | 1·87 | 1·95 | 3·00 | 0·38 |
| 1932 | .. | 0·53 | .. | 0·15 | 2·11 | 2·29 | 6·00 |
| 1933 | .. | .. | .. | .. | 6·60 | 0·88 | 5·99 |
| 1934 | .. | .. | .. | 0·75 | 1·77 | 1·66 | 2·24 |
| 1935 | .. | 0·49 | 0·42 | 2·10 | 1·06 | 4·09 | 3·15 |

| Year | August | September | October | November | December | Total |
|---|---|---|---|---|---|---|
| 1931 | 1·98 | 7·81 | 0·81 | 4·04 | 0·09 | 21·92 |
| 1932 | 3·66 | 4·43 | 10·98 | 4·59 | .. | 34·74 |
| 1933 | 7·42 | 7·04 | 6·01 | 0·12 | 1·71 | 35·72 |
| 1934 | 1·39 | 0·30 | 8·84 | 1·54 | .. | 18·49 |
| 1935 | 14·07 | 14·47 | 8·24 | 8·24 | .. | 38·09 |

*Gardens and Soils.*—There are about 36 gardens round about Madhugiri, *i.e.*, at Siddapur, Gurrammanakatte, Tanne, Mallenahally, Hariharroppa and near Chinkavajra. The fruits from Gurrammanakatte and a few other gardens are noted for quality. Some of these gardens are nearly 50 to 60 years' old. The number of plants in a garden varies from 100 to 800. Pomegranate is not particular as to soil provided the drainage is good; but generally sandy loam is preferred.

*Plants per Acre.*—The normal number of plants per acre can be taken as 200. The distance of planting varies from 13′ to 15′ from plant to plant either way.

*Varieties.*—There are only four main varieties, *viz.*, red sweet variety, red sour variety, green sweet variety and green sour variety, though individual variations are common. Of these, the first-named is the most commonly cultivated variety, while plants of the other three varieties are very few in the gardens. Some varieties are grown as there is demand for these fruits for medicinal purposes and preparing syrups. Sour fruits also fetch a better price when in demand. The quality of the fruits is very good and the taste is not insipid. The fruits are not seedless like the Kabul ones. The colour of the seeds in most cases is red. In the case of the sour variety, the colour is deep red. Seeds of the green sweet variety are softer and their taste is sweeter but since the yield is not so good as the red variety it is not largely cultivated. Weight of a choice fruit will be about 1½ lbs. and that of an average-sized fruit will be about ¾ lb. In some varieties,

the rind of the fruits will be fairly thick, while in others it is thin. In some cases, the rind of the fruits will be very thin and this adds to the keeping qualities of the fruits.

*Selection of Seed and Raising Seedlings.*—For raising seedlings, specially selected fruits from known plants of good yield and quality are allowed to remain on the plants till they are fully mature and then harvested, the juice is then extracted and the seeds separated, mixed with ash, dried in the sun for three or four days and sown broadcast in flat nursery beds, previously treated with heavy doses of sheep manure. These beds are watered and germination is noticed after about a month, when the seedlings appear above ground; it continues up to almost three months. When these seedlings are about 4", the same are picked and transferred to small pots filled with old soil, sand, red earth and sheep manure and watered regularly. Each good fruit gives seeds enough to raise about 800 to 1,000 seedlings. Nursery seedlings in pots are generally sold at Rs. 10 to Rs. 12 per 100 (wholesale rate). The retail rate is 4 annas per seedling. Fruits for raising seedlings are generally sold at 4 annas per fruit.

*Planting and Cultivation.*—Planting in Maghe rains (August) is considered to be the best, as the growth of the plants improves considerably by about the close of the monsoon. Pits 2"×2"×2" are dug up, exposed for some days and then filled with the old soil and red earth almost completely and the plants about 6 months' old are planted in them. Manure is not generally applied at any time during the growth of the plants, but it is customary once every year after the resting period of plants is over (April and May) to apply fresh red earth and old soil (3 to 4 baskets per plant) after digging round the plants, preparing furrows and rings round them for irrigation purposes and removing the soil applied during the previous year. Irrigations are given once in seven days during the ordinary seasons, but during rainy season, if conditions are favourable, irrigations are rarely given. In the case of plants that have come to bearing, irrigations are stopped from *Shivaratri* (February) upto the advent of

Mungar rains (May) and the plants are given complete rest. As soon as the Mungar rains commence, weekly irrigations are continued and plants put forth fresh bloom.

*Harvests.*—If irrigations are commenced from 15 days after *Ugadi* (March), fruits will be ready for marketing from *Gowri* festival (September) onwards up to *Shankranti*; but the best ones are available from *Dasara* onwards (October to middle of January). Two crops are obtained during *Dasara* and *Shivaratri*. Plants begin to bear when they are 3 years old. On an average, 100 fruits can be expected per plant, though some plants bear more than 250 fruits. Even plants of 40 years old have given good crops. Harvesting ripe fruits is a matter of experience. The general indication of ripening of fruits are change of colour and flattening of their sides. Ripe fruits with thick rind burst open a little.

*Marketing.*—Good fruits are sent to outside markets like Bangalore and Hindupur. In the local markets, both high-grade and ordinary ones are generally mixed. The prices locally vary from annas 8 to Re. 1 per dozen, according to quality and size, but choice fruits of extra quality are sold at Re. 1-8-0 to Rs. 2-0-0 per dozen. Sometimes, the annual crop is purchased on a contract which is fixed according to the crop.

*Enemies and Watch.*—Watch is generally kept for about 4 months in the year, when the fruits are getting ready for harvesting. Parrots which do some damage to the fruits are scared away by watchmen. Rats and squirrels are caught by traps and nets. Larvæ of pomegranate moths bore through the young fruits and considerable loss occurs in some seasons. It is better to encase the fruits with muslin bags in the very early stages if this pest is noticed. A light trap in the season to catch adult moths will minimise the damage to the crops in the coming years. Fruits damaged by this pest are to be removed and destroyed.

*Suggestions for Improvement.*—The cultivation methods are only routine and much attention is not paid for improvements, though there is great scope for the same. Similarly,

attention is not bestowed upon grading of fruits; this is to be particularly adopted, for, a little care in this direction pays the gardener amply. If practices like grafting of good varieties from local stock, layering, raising plants from cuttings, introduction of better varieties suited to the tract, pruning of crowded and unnecessary branches, trial of green manures and artificial manures and construction of suitable drainage in the low-lying gardens are introduced into the cultivation system, the gardener can undoubtedly secure better returns. Improvements are also necessary in order that the reputation Madhugiri has earned for its pomegranates may be preserved.

---

## Sheep and Cattle Farming in New Zealand

By

**F. R. Todhunter***

Gentlemen,

I have been asked to speak to you this afternoon, but I feel very like a head shepherd I learnt under once, who hardly ever used to open his mouth. I don't think I can do better than to give you some idea of farming conditions in New Zealand and more especially sheep-farming. I should also like to tell you a little about stock-breeding and to give you some of my impressions of the farming and breeding of sheep in Mysore, although, as I have been here for so short a time and seen so little of your farming conditions, I feel very hesitant in doing this.

New Zealand is essentially a primary producing country and the bulk of our National Wealth comes from farming. In Mysore, New Zealand butter has a very high reputation and I shall tell you, briefly, the conditions under which it is made. Most of our dairy farming is done on good land on farms, up to about 200 acres. The cows are all kept outside

* Mr. F. R. Todhunter is the nephew of Sir Charles Todhunter, Private Secretary to His Highness the Maharaja of Mysore, and a farmer in New Zealand, South Island. Lecture delivered at Hebbal on 12th November 1936.

the whole year round and are only brought into sheds to be milked. These sheds are fitted with the latest milking machines and the milk passes straight from the cow into covered buckets, is weighed, and then goes straight into the separator. All these machines are very carefully sterilized every day and the milking sheds and yards are kept spotlessly clean. The cows are all very carefully tested and graded and a lot of the herds are registered guaranteed T.B. free. In the Butter Factories, cream is only allowed to be taken from farms approved by the Government and Government Inspectors keep a very close watch on all the Butter Factories to see that they are kept clean and their butter is up to standard; this guarantees a very high grade product.

Now for Sheep Farming. Sheep in New Zealand are a very major source of our National Wealth and a large number of our most able men devote their lives to breeding sheep. New Zealand has a very high reputation as a Stud Farm and our horses, cattle and sheep command very high prices in such countries as Australia, South Africa, Kenya, South America and California.

We have a very large range of climatic and soil conditions, and our sheep vary from the Merino kept in the mountains of the South Island, to the Romneys and Lincolns kept mostly in the North Island and the Southdowns, Rynlands, English and Border. Leicesters are kept on the farming land in the South Island. Merinos are kept in the high country for producing wool and the sheep are run on high mountainous country and only mustered together two or three times a year. The size of these flocks ranges from 4,000 to about 40,000 and to muster them in for shearing, etc., it requires very skilled shepherds. These shepherds each have about 5 dogs to help them in their work and many are the tales told in the camps at night about the wonderful work their dogs have done. Most of these shepherds are of Scots extraction and some of them have a very dry sense of humour. One day a new shepherd was mustering on some rather difficult country I know of, and his job was to hunt the sheep round

in front of him or down to the man below him. He put out a rather rough dog and the sheep went down over a bluff and broke their necks. He could not see what was happening; so he got out on to a rock from where he could see the man below and called out: "Are they coming, Phil?"; and Phil, as he watched the sheep breaking their necks over this bluff, replied, "Yes, they're comin'."

On the lower hill country and Downland, half-breds (crosses between a Longwood and the Merinos) and Corriedales are kept. These are dual purpose breeds and kept both for mutton and wool. Then, when we get down to the farm lands, the farmers buy the cull for age ewes from the hills and cross them with Southdown on English Leicester rams and sell the lambs as fats. The flocks on these farms run from about 200 sheep upwards. Our famous Canterbury Lamb was produced by the High country man growing the Merino, the man on Lower hills buying the surplus Merino ewes and crossing them with English Leicester rams to breed half-breds, the man on Downs country buying the half-bred ewes and mating with Leicester rams again to breed three-fourth-bred ewes to mate with Southdown rams to breed the famous Canterbury Lamb. In actual practice, now-a-days, this is not always the case and the Southdown ram is mated with anything from half-breds and Corriedales to cross-breds for the fat lamb trade; but to keep up the quality of the fat lamb, there must always be the Merino foundation.

To keep up all these breeds and flocks, we have special stud farms. These stud flocks are owned by highly skilled breeders who devote their lives to improving the particular breeds in which they are interested, and it is from these breeders that the rest of the farmers buy their rams either privately or at the big Ram Fairs held every year. We now have Inspectors at the Canterbury Ram Fair who rigorously reject any ram they consider unfit to be sold and it has to be a good ram to pass their eagle eye. In this way, we hope to improve the stock of the whole Dominion.

## Stock Breeding

In talking to you about stock breeding, I should like to impress on you not to pay too much attention to theory and genetics. The power of observation and the gift of being able to select and mate the right type of animals is far more important. I think I am safe in saying that most of our successful stock breeders have known very little, if anything, about theoretical genetics. Theories are very apt to let one down when put into practice unless one is a sufficiently experienced breeder to know how to apply one's theories and even then they may not turn out right.

From this, I do not want you to get the idea that genetics are useless; on the contrary, they are a very great help in teaching us to understand the results that we have got. There are so many factors in stock breeding of which we know little or nothing about, that genetics without a lot of practical experience are apt to lead one astray.

Stock breeding is one of the most interesting and disappointing careers in the world and anyone who sets up as a breeder should prepare himself for lots of disappointments and also be prepared to change his theories at any time, but the pleasure of breeding one or two really good animals is well worth it.

Every good breeder should begin with some definite ideal as his model. He may change that ideal from time to time, but he must always have some ideal in his mind's eye to model from.

## Impressions on Mysore

There are one or two things that strike one very forcibly about farming in Mysore. First, there is no attempt made to enclose any of the pasture land and during the day the stock are grazed year after year on the same pasture. This means that the stock eat the pasture during the daytime and leave their droppings somewhere else at night so that the pasture is being continuously impoverished. Also, the stock grazing all the time on the same pasture means that they have

selective grazing and eat out the finer grasses until the coarse grasses gradually take control and smother all the more palatable grasses. This system also means that any parasitic diseases there are in the sheep are left to contaminate the grass and so spread to the sheep again. These pastures have also been tramped for so many years that very little moisture penetrates beneath the surface. In New Zealand, we have all our pasture land divided into blocks and in the farming country into paddocks, and this means that the stock can be changed from one block to another, giving the pasture time to recover and the parasites a chance to die out. On old grass land, we have adopted a system of grassland harrowing, *i.e.*, harrowing that will penetrate the surface of the ground and allow the air and moisture to get at the roots of the plant. Unless there is some system of this sort with old pastures, the grasses tend to become very shallow-rooted and are apt to die off in dry weather. Another thing that strikes a stranger very forcibly is the fact that in the villages, with sheep at any rate, there is no attempt made at proper husbandry. The lambs seem to be left with their mothers all the year round instead of being weaned at the proper time and kept separate. All the male lambs seem to be left to grow into rams instead of being castrated, and it is difficult for the villager to get good rams to improve his flock. Also, and very important, there is no system of culling out the bad sheep and only breeding from the best ewes and rams.

I would suggest that Sheep Breeding Societies be formed in the various districts to encourage the selection of the best type of animal, to improve the animal husbandry to gradually eliminate all the multi-coloured animals and encourage flocks to breed pure white wool, and finally to introduce suitable new blood from another country to improve the local breed. These Breeding Societies should encourage flocks which will be the nucleus for your future stud flocks and in time you should start a Flock Book and register any flocks that are up to standard and have them entered in the Stock Book.

You, students at Hebbal, have a golden opportunity to

help in the Rural Uplift Movement that is so prominent in India to-day and it should be your job to teach and encourage the farmers in this State. Science is becoming more and more prominent in agriculture every year, but do not lose sight of the fact that science and practical experience go hand in hand and while a farmer with practical experience and no knowledge of science may get along alright, a farmer with a scientific training and no practical experience will very often find himself in a bad way. The ideal is a combination of both.

We have a saying that a good farmer is born and not made, but whether this is true or not, every farmer has something to learn and something to improve and it will be your duty to teach the farmers now to improve that something.

Now farmers as a class are notoriously difficult to teach, and are very slow to adopt any new methods, and the best way to teach them is by establishing Model Farms in the different districts so that they can see what is going on at those farms, criticise their methods and adopt what they think suitable for themselves.

# SELECTIONS

## Processing of Honey

During recent years, a process was devised whereby honey is heated to dissolve coarse crystals and to destroy yeasts. The maximum temperature, varying from 130°F., to 160°F., depends on the length of time the honey is heated. The honey is then drained or filtered and cooled as rapidly as possible, to 75 to 80°F. Rapid cooling is essential to preserving volatile flavours. From 5% to 10% of previously processed, sterile, fine crystallized honey is then added and thoroughly incorporated into the liquid honey by mechanical agitation. The mixture is then poured into the market containers and stored at about 57°F., until totally crystallized.

The process has been patented in Canada and Great Britain by the Ontario Department of Agriculture. Licences will be granted to those wishing to prepare a high class product.

—*Fifty-Ninth Annual Report, Ontario Agricultural College, Experimental Farm*, 1933.

## The Idea of the Experimental Union

(Extracts from Speech by **Douglas Hart**, *President, Ontario Agricultural and Experimental Union, 1935*)

It will be fourteen years next spring since I left this College, to go back to the farm. I had a good practical knowledge of farming before that time, but, with the ideas and principles I had learned here and with the enthusiasm of youth, I felt that I soon would have a model farm. But, as you may expect, I was doomed to many disappointments. The principles I had learned were sound but the application of them was just a little different than I had expected when it came to actually putting them in practice. The weather man has a habit every once in a while of upsetting all our plans, then, if he doesn't do it, along comes some fly, bug or worm or may be even a tiny germ of disease that gets into the crops or livestock and leaves havoc in its trail. Also it takes money in many cases to do things as you feel they ought to be done and when your money-lender thinks you have borrowed all you should, you just have to get along without fertilizer. Also many operations require more labour than is available at the particular time; so some things must go by the board.

No matter how sound these experimental results may be, unless we can work them out on our farms with the money and labour available and in face of the weather and all the pests we have to fight, they are not satisfactory for us. To me, this is the greatest advantage of this Ontario Agricultural and Experimental Union. Mr. Squirrell and his associates carry out certain experiments here and obtain certain results. These are always carried on for a period of years in order that accurate results may be obtained. Later these have to be tested on your farm and mine.

This is just what the Union is doing in bringing to many farmers an opportunity to test these crops for themselves, then we know whether it suits our conditions or not. What is satisfactory for you may not be for your neighbour. It seems rather peculiar that this organization which is so useful in disseminating information and better varieties of crops to farmers all over the Province, should be hampered by lack of funds, getting only a few hundred dollars, while millions are being spent on relief which in the estimate of many of us farmers has become the biggest racket of modern times.

I have also been wondering if this idea of the Experimental Union could not be carried to some of our lines of livestock as well.

Similarly, our dairy industry is suffering from a lack of available information on families and strains, both pure bred and grade. The champions at our fairs are often not a very good indication. We know a grand champion bull that sired neither type nor production. Some of our champion cows are not good either as producers or reproducers. They must be tested out year after year on our farms under actual conditions to find this out. In a recent trip to Mt. Hope Farm in Mass, the possibilities of improvement in our dairy cattle through the proving of sires was brought home very forcibly to me. We must have more progeny testing of our bulls here in Ontario, if we are to hold our place in a dairy world. This means we must have more—many more—actual records of milk and butterfat on the farm if all the records of our bulls in both grade and pure bred herds are to be calculated, so that we may know where we are getting that economy of production that we desire. This is no small task, but, considering the importance of the dairy industry in this province, we are doing less here in this line than any other similar dairy district in the United States, Great Britain, Denmark, Holland, Germany or even Australia and New Zealand. If there was an oganization in Ontario to do as much for the dairyman as has been done for the grower of field crops by the Experimental Union, our dairy business would soon be on a higher plane than it is to-day. I just throw out these suggestions that we

must keep in mind the needs of each of our lines of business as improvement of crops and livestock should go hand in hand.

—*Fifty-Seventh Annual Report of the Agric. and Experimental Union, Ontario Department of Agriculture,* 1935.

---

### What is Good Farming ?

The following notes on a paper on "What is Good Farming?", by Mr. C. S. Orwin, read to the Incorporated Society of Auctioneers and Landed Property Agents at an agricultural conference at King's Lynn on Wednesday, September 2, appear in the *Journal of the Ministry of Agriculture*, England, Vol. XLVIII, No. 7, October 1936:—

After a brief historical introduction, he (Mr. C. S. Orwin) postulates the four classic ideas of good farming. These were: (1) good farming is high farming; (2) good farming is mixed farming; (3) good farming is rotation farming; (4) grass farming is good farming; and proceeds to demolish these ideals. High farming is perhaps the easiest to dismiss. He pointed out that, in the depression of the nineteenth century, Sir John Lawes laid down the dictum that high farming is no remedy for low prices. He added, "I am not saying that many farms could not be farmed higher with profitable results. All I mean is that big crops and pedigree stock do not necessarily make a profit balance, and if they do not, then the farming is not good."

Mixed farming is our tradition. It was the backbone of all English farming for centuries and founded the prosperity of the eighteenth century, out of which came much of the capital to support our industrial development. Since the invention of modern fertilizers and modern machinery, however, the necessity for directing the activities of the farm towards the production of large quantities of animal manure is not so essential as it was. This has been demonstrated by a number of farmers whose stories have been told in the series "Progress in British Farming System", edited by Mr. Orwin himself. Again, Mr. Orwin points out that he does not wish to be misunderstood. He wants to suggest that if mixed farming does not pay, it must not be assumed that no profitable substitute for it can be found.

Another tradition that is inbred in the theory of British farming is that a rotation of crops is necessary, and also that particular rotations must be followed on particular soils. Indeed, many leases, as Mr. Orwin says, demand that particular rotations should be followed on a farm rented. Two things occur to us at once in considering these covenants. First, most of them have come down to us with little or no change

from many years ago; secondly, farmers all over the country take very little notice of them. Mr. Orwin maintains that to seek to dictate how the land is to be farmed by means of a cropping covenant that has been copied in the estate office year after year from old tenancy agreements, is to ignore all that we have learnt, in the last generation or so, about the maintenance of soil fertility to overlook the new means at our disposal for keeping the land clean by mechanical power, and to fail to appreciate the changed economic conditions that have made many of the old farming practices and farm products inappropriate.

That grass farming is good farming is the last bogey to be dispelled. We are rightly proud of our grass land, but Mr. Orwin suggests that much of the grass land of England is full of stored-up fertility that cannot be cashed except by ploughing and cropping, and that there are thousands of acres of grass land that would be more profitable to landlord and tenant alike, under a system of alternate husbandry. The work of Professor Stapledon in Wales has long passed the experimental stage, and it has proved conclusively that the productivity of much of the land now under permanent grass could be increased by ploughing, cropping and re-seeding from time to time.

So he admits that the answer to the question "What is good farming?" is not provided by any of these four. For himself, he feels that the resources of modern scientific and technical knowledge, expressed in the cheap fertilizers and the cheap power now available to the farmer, and the changes in the economic situation—due, on the one hand, to the position of Britain as the principal market for the world's surplus agricultural production, and, on the other hand, to the assistance now being given by the Government to certain forms of home production by the marketing schemes, by subsidies, and by import duties and restriction—have changed the whole position on the land. To-day it is so flexible that it is impossible to define good farming by reference to practices that may have been perfectly sound even a few years ago; and the answer to the question he provides is: "Good farming is not necessarily high farming, nor mixed farming, nor farming to a prescribed rotation, nor preserving grass land. It is any farming which maintains the cleanliness and the fertility of the land while enabling the farmer to pay his labour, to pay his rent and get the best possible living for himself." This seems to be sound common sense, and even though, to a few people, it may seem to be almost self-evident, it is worth saying at the end of such an illuminating discussion of the subject.

# Pollen Substitutes

## Gathered by Bees during Phenomenal Spring Conditions

BY

**H. Graham Smith, E.B., S.B.A.,** *Apiary Instructor, Hawkesbury Agricultural College*

The recent acute pollen shortage, a deficiency which periodically affects the development and maintenance of colonies in varying degrees makes the subject of this article one of more than usual interest to bee-keepers. It is many years since such adverse conditions have been experienced in spring and early summer as those lately obtaining in some parts of the State. Such conditions, however, are a natural sequence following seasons of plenty, and have occurred to some extent this season in widely separated districts.

The Hawkesbury district (which, although not considered a commercial honey-producing area, compares well with other localities for building up colonies in the spring) may be taken as an example. In this locality, a very hard winter, with unusually dry weather and severe frosts, was experienced. Most of the bees in this area went into the winter in fair average condition. In some cases, colonies carried into winter considerable supplies of pollen, but these were quickly exhausted when breeding began, particularly in colonies that had maintained their strength well over the colder months, and as early as the middle of August reports were to hand that bees had begun to visit poultry and dairy farmers' barns in search of a suitable substitute for pollen. It is ten years since the last record of such a happening in this locality, and it has never previously occurred to the extent that has been evidenced this season.

One case was noted particularly, that of a poultry farmer who had an apiary adjacent to his farm buildings and who reported that the bees had invaded his barn. As inspection was made, and it was found that tens of thousands of bees were working feverishly on foods that would serve as a substitute for pollen. The contents of the bins to which the bees had access consisted of pollard, linseed meal, key meal, and bran. No attempt was made to prevent the bees from collecting this food, and they worked in the bins with unabated energy for seven weeks.

Interesting observations were made, which revealed that, for a time, the bees favoured the pollard transferring attention next to the linseed meal, which they gathered, as nearly as can be estimated, in quantity approximating four to one. Scant attention was paid to bran, and key meal was not collected by any bees.

After a week or two, there was a marked decrease in the collection of pollard, with an increased interest in linseed meal, which, like the

pollard, the bees began to take home and store in the combs in great quantities. All colonies appeared to work on this substitute, and in one case a colony was found with the combs throughout the brood nest so packed that breeding had come practically to a standstill. The combs in this hive had become fouled and sticky due to the quantity of linseed meal that was being stored. The moistening of the meal for the purpose of packing it into the cells caused it to become adhesive, and in coping with it the workers themselves became considerably daubed. The colony referred to was considerably demoralised until some of the clogged combs were removed and replaced with clean empty combs for breeding purposes.

This condition, however, was not general throughout the apiary. Many colonies used the meal for breeding quite normally as they would natural pollen, without any fouling of the combs. The roughage contained in the meal was eliminated by bees in the hives and deposited in heaps at the entrances. They appeared to use only that which was useful for brood food.

For the greater portion of this period of storing the pollen substitutes, no natural pollen was available in the fields and the bees were dependent upon the substitutes for the continuance of breeding. The results varied in some degree. Those colonies that were strong in bees and with a good reserve of honey continued to breed normally, their strength being well maintained. The weaker colonies also maintained their original strength, but made no noticeable advancement. This, however, might be attributed to the fact that no nectar, which would have stimulated the colonies during the period when pollen substitutes were being used and might have given better results, was being stored.

It would appear to be an essential in any experiment designed to assess the value of any substitutes for pollen that consideration be given to the amount of pollen-bearing honey which may be present in the hive in the form of stores during such period of shortage. Allowing for this, however, it can be said that the entire apiary benefited materially from the pollard and linseed meal available, and that these substitutes carried the colonies over a period which otherwise would have left them in a very weakened condition.

Observations made regarding the longevity of field bees, reared under the conditions discussed, indicate that when such a period is followed by a period of plenty, the workers successfully withstand the strain of field work. There was no noticeable diminution of numerical strength in such colonies located on a medium honey flow following this period of shortage. It is yet to be determined, however, to what extent such a substitute for natural pollen would overcome the extensive

colony impairment at critical periods of the honey flow that unhappily afflicts some of our best honey-producing localities from time to time, and which is still one of the major problems affecting the honey-producing industry in New South Wales.

—*The Agricultural Gazette*, Vol. XLVII, Part 3.

---

## Notes on Tropical Fruits

### Bananas

Of the tropical fruits, perhaps the banana is best known as it is very extensively grown on the coast to supply the principal markets of the Commonwealth. This fruit is produced on a palm-like plant which attains a height of 10 to 12 feet in the dwarf variety, whereas the other varieties are 6 to 8 feet taller.

The banana plant has no seed, and is reproduced by suckers and offshoots which appear on the sides of the parent plant. Striking features about the banana are its rapid growth, its early maturity and the large quantity of fruit produced per acre. About twelve months after the sucker is planted a bunch appears and this hangs down on emerging from the centre of the stem. It will then take from six to eight months for the bunch to mature.

Bananas are always cut green for market and then scientifically ripened. They should be properly ripe before being eaten. It is sometimes stated that this fruit is indigestible, but this only applies to unripe fruit—the ripe banana, however, is not only a fruit of remarkably high food value, but it is a fruit easy to digest. It can be eaten with safety from infancy onwards. Bananas perfectly yellow, with no trace of green tinge remaining, are perfectly wholesome, but an unfailing guide to ripeness, especially where children are concerned, is the appearance of brown flecking on the yellow skin. A good rule is "buy when yellow but eat when flecked".

### Pineapples

The pineapple is a very popular fruit, both in the fresh state and processed forms. The plants grow to a height of upto 4 feet under favourable conditions and bear fruit at the apex of the plant.

Two crops of pineapples are produced in a year, one in the summer and the other in the winter time. The former crop is the best as the climatic conditions are more favourable at this time of the year. Plants only bear the one fruit, when suckers replace them and so continue on the life of the plantation. After about eight years, pineapple plantations are generally uncommercial and should be replanted.

The Smooth Leaf Cayenne, which is a large juicy fruit, is the most popular variety for market. Ripely and Common Queen and Alexander are known as rough varieties, because the leaves of the plants and the tops of the fruits have spiny and thorny margins. These varieties are usually smaller than the smooth leaf cayenne, but they have a better flavour and are sweeter to eat.

### Papaws

This fruit is a popular one amongst the tropical fruits that thrive in New South Wales. Papaw trees grow from seeds. The tree is a small one, seldom exceeding 20 feet in height; it is of a spongy texture, is usually hollow in the middle, and often branchless. It is surmounted by a crown of large palm-like leaves, at the base of which fruit is produced.

Two crops are usually produced, one in summer and another in winter. The papaw has a thick yellow flesh, with a small cavity in the centre, which usually contains a number of black seeds. The skin of the papaw is very thin and delicate when the fruit is fully ripe. The thinness of the skin accounts for ripe fruit being easily damaged and showing blemishes, but this does not detract from the eating quality of the fruit.

The health-giving properties of the papaw are gradually receiving wider recognition. So popular is this fruit that numerous householders grow a few trees to meet their own requirements. As a table fruit, the papaw is delicious and wholesome. The addition of a little orange or lemon juice or passion fruit often improves the flavour.

For salads, papaws are especially valuable. The size of the fruit varies, but most fruit marketed will provide from 1 lb. to 5 lbs. of succulent flesh, which, by the addition of sliced oranges and pineapples or other tropical fruits, quickly makes a delightful salad and one that will allow of generous helping. Iced papaw is very popular. Papaws should not be eaten until the flesh is soft.

Nearly all parts of the papaw have some medicinal value. The most important medicinal properties are said to be found in the milky juice which occurs most abundantly in the green fruit. These properties of the juice are due to the active principle called "papain", which has been long recognised as of considerable value in dyspepsia and kindred ailments. Its digestive action is undoubted, and it is a not uncommon practice to rub a slice of green juicy papaw on tough meat to make it tender.

### Mango

The mango is a handsome evergreen tree, and although it is indigenous to a large tropical area of Southern Asia, it adapts itself to

our climatic conditions. This fruit occupies a conspicuous place in the dietary of millions of people in the tropics. The tree grows to a great size with beautiful foliage. The flowers are produced in enormous numbers in large panicles from the tips of the branches, sometimes nearly covering the whole tree with a mantle of bloom.

The mango is commonly eaten as a fresh fruit. The flesh is yellow to orange and the best varieties have a pleasant aroma and delicious flavour. Some palates may not appreciate the flavour at first, but the mango habit is well worth acquiring in such cases. The mango is utilised in many other ways besides fresh fruit—as for making salads, pickles, preserves, jellies and sauces. Mango chutney is a well-known and popular condiment.

### Custard Apple

The custard apple is aptly named, as it is a very rich, sweet fruit produced on a spreading open tree. The foliage, and particularly the blossoms, have a very distinct perfume. Although it flowers profusely, it is usually a shy bearer. The dark green fruit is generally oblong or heart-shaped, but it is often irregular in shape and size. The fruit has angular markings and turns a light green colour when ripe, when it is strongly perfumed. The pulp is of a creamy colour, and has the consistency of cream; it is deliciously flavoured, but so rich that it cannot be enjoyed if eaten freely.

—*The Agricultural Gazette of New South Wales*, Vol. XLVII, Part 4.

---

## The Pawpaw or Papaw *(Papaya)*

BY

**A. P. Hanson,** *Supervisor of Instructors*

Though the papaw is partial to rich, loamy, well-drained soil, it is found growing under varied conditions of soil and climate all over this island. This is due to the fact that it thrives under subtropical as well as tropical climatic conditions. Now that the fruit has become one of our commercial items, thanks to the existence of the Government's Low Temperature Station, its culture is receiving more attention than formerly.

### Propagation

The plants are very irregular with regard to sex, size, etc. The seeds from one and the same fruit may be expected to produce trees of varied characteristics—male, female, large fruits, small fruits, oblong fruits, round fruits, etc. The need for careful seed selection is evident. In addition to this precaution, a stable and uniform type to be kept up to standard must be bred by constant weeding out of male, and other unsuitable trees.

The trees may be grown from young seedling plants, grown in boxes, or seed beds, and transplanted when 8 or 12 inches high. Generally, however, the seeds are sown in rows, 10 feet apart, and are thinned out 5 to 10 feet in the row, according to the fertility of the soil. The papaw is a surface feeder and should be liberally cultivated, manured, and watered to produce good fruits. The plant will bear heavily in 8 to 12 months, and may last for three or more years, attaining a height of about 20 feet, but the yield decreases when the tree grows old. It is better to replant than to force old trees; but a tree showing signs of decrease may be cut back, when it will produce new shoots about three of which may be retained. These new growths will all produce good fruits.

In the male tree, the flowers cluster at the end of a long foot-stalk, are white in colour, and with a sweet perfume. A male tree may produce small pear-shaped fruits which are of no value.

The female tree produces larger flowers on short foot-stalks. These flowers are yellow in colour, and are bell-shaped. The fruits cluster close to the trunk of the tree. They are often so closely packed as to interfere with their perfect development. To prevent this they should be thinned out. To further improve the size and flavour of one set of fruits, remove the flower buds immediately above. When gathering, thinning or removing parts of the plant, it should be borne in mind that the milky juice falling into the eye has caused blindness. The fruits should be gathered for trade as soon as they show signs of yellow colouring. For export, cold storage is a necessity.

### Uses

From the milky juice of the unripe fruit of the papaw is manufactured the product known as papain. The fruits are incised, the juice collected in non-metallic vessels, dried, and ground to powder. Papain a few years ago was sold at 15/– per pound in London.

As an item of diet, the ripe fruit is to a remarkable degree a wholesome fruit. It is not only palatable and pleasant to the taste, but is a valuable aid to digestion, and general health. In cookery, it may be used for pies and other items.

The unripe fruit makes good pickle and preserves. It makes a dish equal to chocho, or to vegetable marrow when soaked to remove the milky juice, and boiled plain.

This juice is admitted by high medical authority to be an efficient vermifuge, one dose being often sufficient to expel the worms from a child. The seeds also possess a similar property. In the writer's home, the seeds not needed for planting are always fed to poultry, or to pigs. Recently, two pullets, that looked droopy from chickenhood,

were fed a few mornings while empty with about a teaspoonful of seeds, then put up and fed in the usual way later in the day. The change has been remarkable. The drooping tails now point upwards.

It is held that the most remarkable quality of the papaw tree is the property possessed by the milky juice of its unripe fruit, of separating fleshy fibres, and thus making meats tender. The softening action is so powerful that the juice, or bits of the fruit must be used with caution in cooking, or the meat will drop to pieces. For baking, or roasting, the meat is wrapped in some of the leaves. For boiling the juice, or a piece of the unripe fruit, is added to the water.

Some years ago, some interesting experiments were conducted upon this subject at the Royal Agricultural Museum, Berlin. A portion of the juice was dissolved in three times its weight of water, and this was placed with 15 lbs. of quite fresh lean beef in one piece in distilled water, and boiled for five minutes. Below boiling point, the beef fell into several pieces. At the close of the experiment, these pieces had already been reduced to shreds.

There are other accounts showing that this milky juice removes freckles, corn and warts—used cautiously—also that the ripe fruit eaten by dysentery patients have been found highly beneficial.

Considering the many useful properties of this plant, too many fruits are allowed to go to waste in this island.

—*The Journal of the Jamaica Agricultural Society* (Vol. XL, Nos. 2 and 3).

---

## Shade for Coffee Plantations

### Shade in Coffee

It will be convenient to review the question of overhead shade in coffee—based on experience in Uganda—under the following heads: "Experimental" and "General Observations".

### Experimental

The following experiments have been or are being undertaken:—

#### Bugishu District *(Arabica)*

1. Demonstration plots were established at 20 centres in Bugishu District in 1924, at altitudes ranging from 4,000 to 6,500 feet. At each centre there were three plots of 100 trees each, planted at 8 feet × 8 feet, and pruned on the single stem system. One of these plots was planted with permanent shade trees, chiefly *Albizzia* and *Cordia* sp., at 40 feet × 40 feet; one plot was maintained unshaded, and the third was interspaced with plantains as a form of temporary shade at 16 feet × 16 feet. Unfortunately, no systematic record of yields from

individual plots was kept, and in 1933, having served their purpose, the plots were sold to native growers.

From observations made in the period 1931–33, the following general conclusions were drawn:—

(*a*) That plantains as temporary shade were detrimental to the coffee at all elevations, but particularly so at altitudes below 5,000 feet, where only a poor stand of trees remained in the plantain-shaded plots.

(*b*) That at altitudes above 5,500 feet, there was no noticeable difference between unshaded and permanent shade plots. None of the plots were planted at elevations sufficiently high to show the effects of shade on "hot and cold disease".

(*c*) That below 5,500 feet, the coffee in permanently shaded plots was in a more healthy and robust condition than in unshaded plots, suffering less from Hemileia, Leaf-fall and "Die-back".

(*d*) That at elevations below 5,000 feet in unshaded plots, biennial fluctuation in cropping was very noticeable, whilst in shaded plots the cropping was more even.

2. Artificial shade experiment at Bugusege Plantation; planted 1932.

*Treatments.*

(*a*) Shaded throughout the year except for one month unshaded, beginning with the flowering season.

(*b*) As (*a*), but beginning to remove shade one month earlier.

(*c*) As (*b*), but beginning to remove shade one month earlier.

(*d*) Permanent shade of same intensity as (*a*), (*b*) and (*c*).

(*e*) Control; no shade.

*Lay-out.*

A 5 × 5 latin square, with 16 trees per plot and two guard rows surrounding each plot.

*Cultural.*

The trees are pruned on the modified multiple stem system, but in March 1936, they were stumped and trained on the single stem system. Those trees within the experiment from which yields are recorded are mulched with banana leaves twice a year; guard rows are unmulched and clean weeded. Shade was erected at a height of 9 feet from the ground between October 1933 and March 1934, bamboo slats being used on a wooden framework.

*Observations.*

(*a*) *Vegetative Growth.*—The trees grew normally until the shade was erected, after which those under shade became somewhat

etiolated in 1934 and more so in 1935, to such an extent that it has been necessary to raise the shade to 10 feet. The average distance between nodes is about 2.9 inches, as compared with 2.4 inches in unshaped plots. The leaves are a darker green colour under shade and thicker in texture. Secondary growth appears to be repressed under shade.

(*b*) *Flowering.*—In shaded plots, flowering has been delayed compared with unshaded trees. In 1935, the lag was about three weeks.

(*c*) *Fruiting.*—Fruiting over the whole experiment has been delayed about a month as compared with corresponding trees in another unshaded experiment, planted at the same time. The unshaded plots in the experiment were no earlier than the shaded plots, which points to another effect besides that of light intensity. From the first crop (1934–35 season), there were no significant differences between yields of the different treatments. The cherry does not ripen to such a good colour as in unshaded plots.

### Bakulasa (*Robusta*)

#### Shade and Cover Crop Experiment

*Treatments.*

(*a*) No shade; clean weeded.
(*b*) No shade; permanent cover crop (*Centrosema pubescens*).
(*c*) Banana shade; clean weeded.
(*d*) Banana shade; permanent cover crop.
(*e*) *Gliricidia sepium* shade; clean weeded.
(*f*) *Gliricidia sepium* shade; permanent cover crop.

*Lay-out.*

A 6 × 6 latin square, plots 70 feet × 100 feet, coffee planted 10 feet × 10 feet square, shade trees planted 20 feet × 20 feet diagonal.

*Cultural.*

The coffee is grown on a three-stem system, all suckers being removed and new suckers allowed to grow only when an old stem is cut back. In September 1933, half the *Gliricidia* shade was removed, and the remaining *Gliricidia* shade has been pruned periodically.

Results to date are:—

*Shades × Covers.*

(*a*) Clean weeding is better than the cover crop under no shade and banana shade.

(*b*) No shade and banana shade better than *Gliricidia* shade, when the ground is clean weeded.

(*c*) No shade and *Gliricidia* shade better than banana shade with the cover crop.

That is, banana-shaded plots are spoilt by a cover crop; unshaded plots are depressed by a cover crop; *Gliricidia*-shaded plots are not significantly depressed by a cover crop, for the *Centrosema* makes less vigorous growth under shade.

*Shades* × *Years.*

(*a*) To date, no difference between banana shade and *Gliricidia* shade.

(*b*) No shade good in first year, *i.e.*, better than banana shade.

No shade better in the second year, *i.e.*, better than banana shade and *Gliricidia* shade.

No shade crops in the third year, *i.e.*, to the same level as banana shade and *Gliricidia* shade.

### Bakulasa: Types of Shade Tree

Demonstration and observation plots are being established, with *Robusta* growing under the following shade trees:—

(*a*) Natural (*Acacia* sp.).
(*b*) Mutuba (*Ficus* sp.).
(*c*) *Albizzia stipulata.*
(*d*) *Erythrina* sp.
(*e*) *Leucæna glauca.*
(*f*) No shade.

### General Observations

(*a*) Based on numerous observations, made over a considerable number of years, the Entomologist is of the opinion that from a pest point of view, the provision of overhead shade is undesirable, both Stephanoderes and a Capsid bug (*Lycidocoris*) being definitely favoured by shade conditions. The position of Antestia is uncertain, but again this pest seems to prefer shaded conditions.

(*b*) *Robusta* coffee is, in its natural habitat, a shade-loving species. In some cases, when growing wild under forest conditions, its growth is so dense as to form a complete undergrowth. On the Sese Islands and in Kyagwe (Mengo District), many instances can be seen of very old trees in very healthy conditions growing under shade, whereas large numbers of *Robusta* trees planted by natives in recent years without shade have died after bearing one or two crops. This dying out at four or five years old is due to failure to control weed growth, more particularly grass weeds, accentuated by the tendency of *Robusta*, when unshaded, to overbear when young. The provision of proper shade tends to prevent this heavy overbearing in the early stages and

to a marked degree keeps down the growth of weeds. There is no doubt that under Buganda conditions *Robusta* can be maintained in good condition for many years by proper attention to cultivation, *i.e.*, by control of weed growth, and more especially when the ground is mulched —and the same applies to native-grown *Arabica* in Bugishu District— but observation tends to show that if the trees and the land in which they are growing are neglected, *Robusta* will live longer under shade than is grown unshaded.

(*c*) In Bugishu, at altitudes between 5,300 and 6,300 feet, shade for coffee appears to be unnecessary, but below this range it appears beneficial by reducing biennial fluctuation, and in the colder climate above 6,300 feet, it may be beneficial; but this latter point has not been proved.

(*d*) An experiment now being undertaken on the Kampala Plantation has the following treatments:—

*No Shade.*

(*a*) Permanent cover crop.
(*b*) Weed cover; slashed periodically.
(*c*) Mulched with elephant grass.
(*d*) Clean weeded.

*Overhead Shade.*

Periodical green manure.

Throughout the experiment, once a fortnight, estimations have been made of the water content and of the nitrate content of the soil. With regard to moisture content of the mulched plot, it is always much higher than that of any other treatment. At first, the shaded plot and the clean-weeded plot showed a higher content of nitrates than did the other plots; while the shaded plot has continued to be pre-eminent in this respect, the clean-weeded plot now differs but little from the other plots; in fact, for some months the mulched plot has been slightly richer in nitrates. In addition, records of soil temperatures and of evaporation as measured by Piche tube have been kept. With regard to soil temperature, it has been found that at a depth of two inches the temperatures recorded under shade show much less variation than those in the open, and that the maximum temperatures under shade may be as much as 10 degrees lower than those recorded in the open. Trials with Piche tubes at Kampala have shown that there are only relatively small differences between the records obtained from the tubes suspended at heights of 2 feet, 4 feet and 6 feet above the soil in any one place, and that the rate of evaporation among coffee under shade is always slightly below that among unshaded coffee.

(*e*) It is suggested that experiments undertaken to determine the effect of shade or of a particular ground treatment should be on a scale sufficient to allow costings to be kept. For example, when consideration is being given to the comparative merits of shade and grass mulching, while it may be found that grass mulching gives the heaviest yields, the cost of mulching may be out of all proportion to the increased yields obtained, and it may be economic to sacrifice maximum yields and to be satisfied with lower yields each year, with low weeding costs, which result might be obtained by the provision of suitable overhead shade.

(*f*) When new land is being cleared for coffee, if shade is desired, a number of native trees appear to be suitable. For example, the figs, Mwafu (*Canarium Schweinfurthii*) and Muisizi (*Mæsopsis Eminii*), although not leguminous, are regarded as beneficial, whereas the Mperwere (*Piptadenia Buchananii*), although it is leguminous, is reputed to be unsuitable. Of introduced trees, our present experience indicates that *Albizzia stipulata*, although not perfect, would be the most generally useful, and, if shade was being tried in native plots, this tree or the native Mutuba (*Ficus* sp.) might be used.

(*g*) The Assistant Botanist is of the opinion that for the establishment of *Robusta* coffee by natives, there are certain advantages to be gained from the proper use of bananas as shade. This practice has been followed by the natives of Uganda, who have been growing *Robusta* coffee perhaps for hundreds of years, and there are to be seen many instances of coffee and bananas, both widely spaced, and both in excellent health. It is true that the coffee under these conditions may form excessively long internodes, but it is considered that this disadvantage is more than compensated by the reduced competition from weeds that such coffee enjoys, when compared with coffee planted in the open, for it is difficult in Buganda to induce natives to pay proper attention to a crop from which they are obtaining no immediate return.

4. *Nyasaland.*—Memorandum by the Department of Agriculture, Nyasaland:—

In the coffee areas of Nyasaland, the climatic year can be divided into six wet months and six dry months. During the dry period, the lower limit of average rainfall, which is regarded as essential, is five inches. As a rule, much of the dry-season rainfall is ineffective, and the long dry spell must be met by the provision of shelter belts, shade trees and surface mulches.

Various trees and plants are under trial in Chholo and Zomba Districts. They include the indigenous *Brachystegia* and *Upaca*, examples of which have been left in clearings, *Albizzia*, *Acacia*, *Schibolobium* and *Grevillea* for high shade. For medium shade and hedges,

*Sesbania, Gliricidia maculata, Derris robusta, Millettia obalata, Cytisus alba,* and *Cajanus cajan* are in use.

5. *Northern Rhodesia.*—Memorandum by the Department of Agriculture, Northern Rhodesia:—

Coffee is grown at Abercorn at altitudes between 4,000 and 6,000 feet. The majority of the existing plantations were established after 1928. The average rainfall is about 45 inches, distributed between September and May, and irrigation is desirable, if not absolutely essential.

Shelter from prevailing winds is unquestionably necessary, but the need for shade is at present doubtful. *Tephrosia vogelli* has been found satisfactory as a temporary shade and shelter for young coffee grown under irrigation.

Observations on estates where certain indigenous trees were left to provide shade have shown that moderate stands of the following are at least harmless:—

*Parinarium mobola.*
*Afrormosia angolensis.*
*Pterocarpus angolensis.*
*Albizzia antunesiana.*
*Albizzia gummifera.*

On the other hand, most of the *Brachystegias* and *Isoberlinias* (particularly *I. paniculata*) are harmful, and an unidentified species of *Anisophyllea,* in particular, inhibits the growth of coffee near it.

—*The East African Agricultural Journal of Kenya, Tanganyika, Uganda and Zanzibar,* Vol. II, No. 1.

---

## Some Observations on the Methods of Making Clarified Butter (Ghee) with Some Notes on a New Method

BY

**M. H. French, M.A., etc.,** *Biochemist, Department of Veterinary Science and Animal Husbandry, Tanganyika Territory*

In hot countries, milk and butter cannot be stored for any length of time. Also, in most of the dry, hot regions of the world, the yield of milk fluctuates considerably with the season of the year. The inhabitants of such semi-arid regions were forced to evolve a method of storing dairy products, prepared during the rainy period, for use during the drought period when no surplus milk can be obtained. Such a process was developed in India and has since spread to other subtropical countries. The original Hindustani name for this product was "Ghi", and this term, written as "ghee", has been retained by most producing and marketing countries.

The principle underlying the production of ghee is the preparation, in a solid form, of milk fat free from water, proteins, and salts, *i.e.*, "clarified butter", as it is known in Western civilization. The methods in vogue for producing this article vary greatly, from the crude native methods to the refined method of the European *chef* who prepares his "clarified butter" from high-quality fresh butter.

Theoretically, the milk of any animal species could be used in the preparation of clarified butter or ghee, but in practice it is made chiefly from the milk of cows and buffaloes, though occasionally it is also derived from sheep and goat milk.

In the country districts of India, one still finds ghee being prepared by the old historic methods. Immediately after milking, the milk may be sterilized by heating it for an hour or more, but more often no sterilization of this kind is carried out. The milk is put into a large earthen or brass jar and inoculated with a starter of sour milk. When the milk has curdled it is diluted with warm water and churned with a split bamboo or crude wooden vanes, which are twirled by hand, until the butter forms. The granules of butter are skimmed off the surface and allowed to stand for some time for excess water to drain away. During this period much rancidity develops. The butter is then clarified by heating in an earthen or brass pot. After all the steam has boiled off, the mixture is allowed to stand for the protein to sediment and then the liquid fat is poured off into containers.

In East Africa, this is still the method used by many natives. The preliminary souring of the milk is done in gourds and churning consists of shaking the contents of the gourd until butter begins to form. The butter is collected and mixed with the butter from churning during several previous days. It is stored in an earthen pot and whilst standing gets thoroughly contaminated with dirt and insects. Boiling into ghee is done on a smoky wood fire when enough butter has accumulated to make this operation worth while. Native-made ghee prepared in this way is a white, tallowy, semi-liquid fat, smelling offensively and full of insects and dirt.

Kothavala and Cox have recently pointed out the inefficiency of these old methods of manufacture when compared with modern procedures.

The first big step towards improving the method of preparation was the introduction of the separator and churn. The improved method which is being used in most countries employs both these instruments. The milk is separated as soon as possible after milking and the cream allowed to ripen, with or without the addition of a starter. The ripened

cream is churned and the butter thoroughly washed, and after standing overnight is boiled into ghee.

* * * *

The cream from native-produced milk possesses a very mixed bacterial content and probably not the types most suitable for producing the right type of acidity in the cream, or the finest flavour in the butter. Theoretically, it is necessary to sterilise the cream and then seed it again with a starter containing the right bacteria. In practice, this means extra work for the creamery staff and it would be almost impossible to keep a starter free from contamination with the undesirable bacteria which must be floating about in the air of a creamery in a hot district.

Experience in the creameries has now shown that cream ripens very quickly without the addition of a starter and possesses the right acidity for quick churning in from 12 to 18 hours. The addition of a butter-milk starter is very liable to cause over-ripeness of the cream and results in more difficult churning and a poorer quality of butter.

Much depends on the butter being churned correctly. In Tanganyika Territory, metal rotary churns have been adopted as the most suitable. They are very easy to keep clean, even when this is left to a native, and require no attention during the close season. The instructions of the maker should be followed very carefully, though the amount of washing that has been found necessary is much more than they recommend. Six washings of the butter is now the recognised procedure in the creameries. Over-churning the butter must be strictly avoided, because if this happens the butter loses its grain and becomes lumpy and is then most difficult to wash properly.

Tests made on fresh butter correctly churned and well washed have shown that it possesses no trace of rancidity. On the other hand, samples of good butter that have not been washed sufficiently show a slight rancidity. All butter that has been over-churned shows a rancid reaction and it is practically impossible to free completely such butter from the butter milk.

During the boiling of the butter, the proteins are precipitated and the water is removed in the form of steam. The lower molecular fatty acids produced by the lipolytic action of micro-organisms are slightly soluble in water and distil off in the steam. This means that butters possessing but a slight rancidity when put on to boil lose all these volatile acids during clarification. On the other hand, it has been shown that in those butters which have developed rancidity the usual period of boiling is not sufficient to remove all the volatile products and the clarified butter may show a small amount of rancidity. Even this can be overcome, as happens in Indian-made ghee, by boiling for a longer period. However, this over-boiling results in an inferior product, which does

not possess the solidity, grain, colour or taste of the good clarified butter from the creameries.

Therefore, for the production of good clarified butter from ordinary butter, the following points are of particular importance:—

(*a*) The cream should ripen for as short a period as possible. Usually starters will not be found necessary in hot countries.

(*b*) The butter must be churned correctly and then very thoroughly washed.

(*c*) Butter should be clarified as soon as possible after churning.

(*d*) The butter must be correctly boiled.

The boiling of the butter is not such an easy procedure as one would at first imagine. Boiling must take place steadily and be neither too slow nor too fast. Many trials have been made by the Veterinary Staff to find out the best type of stove for boiling. Wood is the fuel used in all creameries and much difficulty was at first experienced owing to the wood being wet. If boiling is to be uniform, the wood must be quite dry. Charcoal is used as the fuel in some countries, but it seems unnecessarily expensive.

Boiling takes place much more uniformly if the top of the stove is recessed to take the boiling pan. The flames of the fire should never play directly on the pan, which should rest on a metal surface covering the fire. Great care is necessary to see that the smoke is led away properly, because clarified butter readily acquires a smoky taint. The boiling pan should be of metal and have as large a diameter as possible, because in this way heating takes place much quicker than in a deep, small-bottomed pot.

Clarifying the butter is regarded as an art and it is quite impossible to lay down rules as to the correct period necessary if boiling is to proceed at the optimum rate. There are so many factors involved that the time is never constant in any one creamery. Thus, 56 lbs. of butter may take anything from 20 to 90 minutes to clarify correctly. Further, it is impossible to say that boiling should be continued until a definite temperature is reached. I have found that the final temperature of the clarified butter when ready to be removed from the fire may vary between 110°C. and 140°C., but usually averages about 128°C. for many boilings, both in the laboratory and in the creameries. When using good quality butter, I recommend that the boiling should be as brisk as possible without running the risk of the molten butter foaming out of the boiling pan.

As examples of the variations in times of boiling, Table I shows the protein, moisture, and temperature changes of the clarifying butter as the boiling period is lengthened:—

TABLE I

*Changes in the composition of butter during clarification*

| Sample No. | First test | | | | Second test | | | |
|---|---|---|---|---|---|---|---|---|
| | Interval of time | Temperature | Moisture | Protein | Interval of time | Temperature | Moisture | Proteins |
| | Mins. | °C. | Per cent. | Per cent. | Mins. | °C. | Per cent. | Per cent. |
| No. 1 (butter) | 0 | 24 | 15·52 | 0·92 | 0 | 28 | 14·82 | 0·58 |
| No. 2 | 5 | 94 | 14·53 | 0·88 | 20 | 94 | 13·20 | 0·35 |
| No. 3 | 10 | 94 | 9·95 | 0·55 | 30 | 94 | 10·5 | 0·29 |
| No. 4 | 18 | 96 | 1·07 | 0·42 | 40 | 98 | 3·0 | 0·17 |
| No. 5 | 23 | 108 | 0·39 | 0·36 | 50 | 114 | 0·2 | 0·09 |
| No. 6 (Clarified butter) | 28 | 130 | 0·01 | 0·03 | 58 | 124 | 0·00 | 0·02 |

The first test took less than half the time required by the second; yet the final product is just as good.

Rules can be laid down whereby the operator can judge correctly the point at which the butter is clarified and ready to leave the fire. The physical changes taking place are as follows:—

(*a*) Butter commences to melt at 30°C. and by the time the temperature has risen to 64°C., all the butter will have melted.

(*b*) A foam forms on the surface and this increases in volume until a temperature of 94°C. is reached.

(*c*) The liquid butter starts to simmer at 94° to 96°C., and the temperature remains about constant until nearly all the water has boiled off.

(*d*) The contents of the boiling pan become much thicker and resemble the custard. As the last of the water is boiling off at 98°C., bubbles begin to break with sufficient violence to cause a small amount of spitting.

(*e*) The curd begins to form into lumps as the temperature approaches 110°C. Many large bubbles break on the surface at this stage and much of the protein precipitate is carried up and forms a scum on the surface.

(*f*) The protein particles contact as the temperature gets near to 120°C., and sink to the bottom of the pan. The scum disappears from the surface and the general appearance is that of a clear, amber-coloured liquid with white protein particles in suspension near the bottom of the pan. If boiling is stopped at this point, the ghee possesses a peculiar smell which is aptly termed "unripe" by the natives.

(*g*) As the temperature rises above 120°C., the large bubbles are gradually replaced by smaller ones, until suddenly a foam of small bubbles is formed closely resembling in appearance "soap-suds". This foam rises rapidly and at this point the pan must be quickly removed from the fire.

A method of checking, if the correct point has been reached, is to observe the colour of the protein sediment as soon as the bubbles disappear. If these particles are lighter than the supernatant butter fat, then boiling has been stopped a little too soon. These particles take on a slightly darker colour than the liquid if clarification is complete. When the fat has been overboiled, the protein sediment becomes charred and black.

When correctly boiled, the clarified butter is filtered into the containers.

During boiling, it is very necessary that the contents of the pan are stirred gently and continuously, otherwise, charring will take place and the quality be ruined. When the protein curd begins to sediment, it is essential that viogorous stirring be avoided, otherwise the clarified butter will be cloudy in appearance due to the fine protein suspension which passes through the strainers.

Some authorities advise that the scum should be skimmed off during the clarification of butter. This point has been investigated and was found not to be necessary. All the protein removed by this skimming would be precipitated in any case, whereas its removal means extra work and boiling for the operator.

If overboiled, the clarified butter loses its attractive colour and takes on a dirty white hue. It smells charred and tallowy and loses its grain, whilst in many cases it remains liquid. When kept simmering for a long time at moderate temperature, an oily product results, which never solidifies completely.

Work on the solidification of clarified butter has shown that small lots solidify much more quickly and uniformly than do large bulks. When filling large containers of 28 lbs. capacity, or over, it is advisable only to fill the tin one-third full at a time, the first lot being allowed to solidify completely before subsequent lots are added. Very hot fat should not be poured on already solidified clarified butter, but should only be added when nearly cold.

It has also been shown that the containers must not be sealed whilst the fat is still hot, otherwise a vacuum is produced which considerably delays solidification.

Clarified butter should possess an attractive yellow colour and be either free from smell or possess a faint toffee odour. At all ordinary temperatures it should be solid, with a well-marked granular consistency. Normally, it should have a sweet taste, free from rancidity, and in the best samples should resemble butter. When rubbed on the palm of the hand, it should readily liquefy. As clarified butter is free from protein and water, and it does not become mouldy or decomposed by the activity of micro-organisms. If well stored, it will keep indefinitely.

There are certain deteriorating chemical changes which may take place in clarified butter. I refer to the autoxidation of the butter fat. This change is accelerated considerably by exposure to ultra-violet light, free contact with air, high acidity of the cream before conversion and is catalysed by the presence of certain metallic elements (iron and copper). The autoxidation is accompanied by bleaching and the development of a tallowy smell and taste. Such changes are detected even in the early stages by the Kreis test; all clarified butter prepared

under veterinary supervision in the Territory is subjected to this test and only samples giving a negative reaction passed. Although autoxidation readily occurs under certain conditions, it does not take place if the fat is stored in full, sealed containers in the dark.

In an experiment at the laboratory, a sample of clarified butter was divided into seven lots and subjected to seven different treatments for a period of six weeks with the results shown in Table II. Each small sample was contained in a glass jar, which was completely filled to the stopper.

TABLE II

*Deterioration of clarified butter by autoxidation*

| Treatment | Effect on colour | Effect on taste | Development of positive Kreis test |
|---|---|---|---|
| Sealed with wax and exposed to sunlight | Nil | Nil | Nil |
| Loosely stoppered and exposed to sunlight | Slight bleaching round stopper | Tallowy only round stopper | Positive in top layers but negative beneath |
| Plugged with cotton wool and exposed to sunlight | Completely bleached | Tallowy | Strongly positive throughout even after diluting 1 in 20 |
| Plugged with cotton wool and kept in the dark at 0°C. | Nil | Nil | Very faint trace in surface layer |
| Plugged with cotton wool and kept in the dark at 24°C. | Nil | Tallowy only in surface layers | Trace in surface layers only |
| Sealed with wax and kept in the dark at 24°C. | Nil | Nil | Nil |
| Loosely stoppered and kept in the dark at 24°C. | Nil | Nil | Very faint trace round the stopper |

This experiment demonstrates how the Kreis test detects changes not yet apparent to the taste or in the appearance of the clarified butter.

Further, the results show that, in the absence of sunlight, autoxidation proceeds very slowly, even though the fat is exposed to the air (oxygen). In the absence of air, even sunlight produces little or no change. Thus, if clarified butter is kept in filled metal containers, it can be stored for very long periods. When the containers are opened, they should be kept in a dark spot or protected from sunlight. In the small samples tested in the laboratory, a month was necessary for complete bleaching of a 30 gm. sample of clarified butter, even when

continuously exposed to sunlight and air, so that under ordinary conditions a housewife need not fear that a large tin of clarified butter will deteriorate before she has used it up completely.

### A New Method of Making Clarified Butter

In the older methods and in the method used in most countries to-day, butter is prepared and clarified later. It has been pointed out above that the ripening of cream cannot be controlled very easily owing to the risk of contamination by undesirable types of bacteria. These unwanted bacteria give rise to many side products which, though present in minute amounts, detract from the flavour of the butter produced. Also over-ripening of the cream with a large production of acid results in a butter of poor-keeping qualities. Further, even when clarified, butter from highly acid cream is more liable to autoxidation than if made from cream of the right acidity.

Also the butter has to be churned correctly, otherwise efficient washing is impossible and the resulting clarified butter possesses some of the rancidity developed during the ripening of the cream.

In any case, the boiling process cannot be eliminated.

In an effort to simplify the production of clarified butter so that a first-class article could always be turned out, the direct boiling of cream was tried. Cream contains very much more protein and water than butter and the only reason for making butter as an intermediate step in all the older processes is to reduce the quantities of these before boiling.

As was to be expected, both in the laboratory and creamery tests on the boiling of fresh cream, the direct boiling was not a success.

The large amount of protein present caused some to stick to the bottom of the pan and char, thus reducing the quality of the final product.

An attempt was then made to reduce the amount of protein present by washing the cream with water. This was accomplished by mixing the cream with water so as to make a volume equal to half that of the original milk separated. This cream emulsion was then reseparated. By this means, the protein content was reduced to about the same percentage as is found in butter. Laboratory trials showed that this washed cream could be clarified without difficulty. Further trials on this method have been made on the Government dairy farm and on a large scale in one creamery. All the reports show that this method is working perfectly satisfactorily under creamery conditions.

In this washed cream method, the small amount of rancidity present in the freshly-separated cream from native milk is partially removed

by washing. The small amount left in the washed cream disappears during boiling. The result is that the product can be guaranteed absolutely free from rancidity. Further, since it is made from fresh cream, its keeping qualities are better than that from butter produced from acid cream.

By general consent, this clarified butter is graded as the best turned out in the Territory. It has a good colour, is always solid below 30° C. and in my opinion is better than the best Indian-made article. Its taste resembles butter very closely. The Vitamin A content of this fresh cream clarified butter is much (3 times) higher than in the normal creamery product.

The loss of butter fat in re-separating the milk will not be more than is lost in the butter-milk, the butter left in the churn and on the butter working table. Yields from the creamery confirm the small-scale laboratory tests that there is no appreciable difference in yield of clarified butter between the standard and the new methods.

The washing of the cream and re-separating is absolutely mechanical and eliminates the need for an intelligent butter maker. This means that there is a saving on the utensils and skilled labour whilst a better product is turned out.

—*Bulletin of the Imperial Institute,* Vol. XXXIV, No. 1.

---

## Potato Growing in Victoria

### No. 9. Harvesting and Grading

BY

**J. T. Ramsay,** *Potato Expert*

The harvesting of the Victorian potato crop extends over a considerable portion of the year. In the Western District (Koroit-Warrnambool) and on the Mornington Peninsula (Brighton-Cheltenham), digging commences towards the end of October. Owing to their proximity to the sea these districts are favoured with such a mild climate that planting may be done shortly after mid-winter without much danger from damage by frost. Digging continues right through the season, from October till July, and even later in some seasons, so that harvesting takes place over at least nine months of the year. In occasional seasons, during which such low prices prevailed that growers did not feel disposed to incur the cost of harvesting, but at the tail end of which a sharp market recovery took place, digging actually has been done up to the end of September.

In certain soils, particularly well-drained volcanic loams in the cooler districts (Ballarat and Gippsland hills), potatoes left in the ground until late in the season keep in excellent condition, in fact, just

as well as if harvested and pitted. While this procedure may be quite satisfactory, so far as keeping the potatoes in sound condition is concerned, it has the big disadvantage that it prevents cultivation being given to the paddock, and tends to make the land very dirty, thus adding to the difficulties and cost of digging. Another drawback to deferring harvesting much beyond the date of ripening of the crop, is that the land is lying idle instead of being sown with a following crop as soon as it otherwise might be.

Harvesting is done both by hand and machine. Where the soil conditions are suitable, the latter is the more efficient and economical method. Working under right conditions, the machines will dig faster, cleaner, and with less damage to the tubers than hand diggers, while, in addition, the machines are ideal cultivators, and leave the soil in a perfect condition of tilth.

There are two distinct types of diggers on the market—the rotary and the elevator type—while a third and new type, an Australian invention, will be available shortly.

The rotary type operates with a loosening share set to a depth just lower than the deepest potatoes. As the soil and the tubers are forced over this share by pressure of the soil in front of the machine, they are met by a series of spinning or rotary forks which, revolving at fairly high speed, pulverize the soil, separating it from the tubers and leaving the latter spread on the surface of the ground on the right-hand side of the machine ready for picking up. This rotary type of digger is quite suitable for hilly or flat country, and is quite within the power of two ordinary draught horses. In working this digger, it is necessary that each row be picked up before the next is dug, otherwise some of the potatoes in the row previously dug will be covered. This means that a squad of from ten to twenty pickers (according to the crop) will be needed to keep the machine going steadily. Under normal conditions, 3 to 4 acres per day can be dug by this machine.

With the exception of the loosening share, the elevator type of digger works on an entirely different principle. After the soil and tubers have been forced over the share, they land on to an endless travelling chain which carries them to the rear of the machine. In travelling along this chain belt, the soil is agitated and pulverised, and drops through between the links of the chain, so that practically only the potatoes and haulms are delivered behind the machine in the same row as that in which they were grown. This type of machine is heavier in draught than the rotary, but does excellent work under reasonable conditions. One disadvantage of the elevator digger is that it will not dig satisfactorily on a steep down grade. On flat or gently undulating country, it is effective. The new type of digger now being placed on

the market has immediately behind the share a comb which is spinning in the opposite direction to that in which the machine is travelling and which separates the soil from the tubers effectively, and leaves them on the surface along the row in which they grew. This machine has the advantage of lightness in draught, together with efficiency in digging.

All of these types of digger may be operated (provided the soil conditions are reasonably fair, *i.e.*, not too wet and not too hard) in crops ripe or unripe. In setting a mechanical digger, care must be taken that the loosening share is set at the correct depth. If set too high, considerable damage will be done by cutting the potatoes: if set too low, the draught will be appreciably increased, and there will be a tendency to cover the tubers instead of leaving them exposed on the surface of the ground. Plough digging is sometimes resorted to, and a special double-breasted prong attached to a plough frame (as illustrated) is used for this purpose. This implement is suitable for light sandy soils, but not for heavy types of land, unless these are in exceptionally loose condition. Notwithstanding the efficiency of digging machines, the bulk of the Victorian crop is harvested by manual labour.

Irrespective of the method employed for lifting the crop, the heavy harrows should always be used after digging and bagging. This exposes practically all tubers which have been inadvertently covered, and reduces trouble from self-sown plants in the succeeding crop. In extreme cases, where the ground is very hard or very wet at digging time, it may be necessary to use the spring-tooth cultivator to discover the tubers which have been missed. From time to time, attempts have been made to arrange for an automatic "picker-up" and bagger to be attached to mechanical diggers. These have not been a success, chiefly on account of the machines not being capable of discriminating between potatoes and stones or lumps of soil. Notwithstanding the fact that it has not been possible to devise a satisfactorily combined digger, picker and bagger, the digger itself is a machine of considerable economic importance to the large-scale potato-growers, being both efficient and speedy.

The earliest harvesting (about the end of October) is generally commenced before the crops have ripened, and because potatoes at this stage are very soft in the skin and liable to injury, they have to be marketed in cases. This reduces to a minimum the bruising of the skin and consequent discoloration of the surface of the tubers which quickly takes place when the tender skins are roughed up.

The later crops in Victoria generally are allowed to mature fully before being dug. Fully ripe tubers are marketed in bags for the sake of economy. These bags run about fourteen to the ton, though some growers, in order to save bags, fill them almost to overflowing so that when sown the top layer is only kept in the bag by the sewing twine,

and is entirely unprotected from the weather. Unless the potatoes are quickly disposed of, this is false economy as the top layer is subject to damage by greening (the action of light) or frost. A parcel of potatoes with the bags neatly and closely sown is much more attractive than one with the mouths of the bags gaping wide open, and generally the extra value received will compensate for the few extra bags required for a truck load.

### Grading

The grading of the crop is an important operation which is frequently neglected. Several methods of grading are in use, the most common being by hand, though grading riddles and mechanical graders, which involve considerably less labour, are coming gradually into vogue. When this work is done entirely by hand, it is a most tedious process, necessitating the handling of each individual tuber.

An economical method is the use of hand-operated grading riddles. A set of these consists of one large diameter riddle (32 inches diameter) with a mesh of ¾ inch. This permits only soil to pass through. This riddle is supported on a barrel (preferably one with the bottom knocked out of it) or other convenient rest. Above the large-diameter riddle, one of the smaller diameter (26 inches) is operated. The mesh of this is anything from 1¼ inches to 2 inches, according to the grade required. If three grades are required, then three riddles are operated at one time by which means market size, seed, and chats may be separated with expedition at one operation. The market size tubers are caught on the top riddle, and delivered from there into the bag direct. The smaller mesh riddle underneath catches the seed, and when this contains enough it is lightly shaken to shake the dirt through, and the seed is then delivered straight into the seed potato boxes, which are placed in a convenient position. Shovelling from the heap is done with a special wire shovel, which can be operated on the uneven bottom of a pit or on a wooden floor, with little risk of damage to the potatoes. When the tubers are spread on the riddle from the shovel, the operator is able to see at a glance and remove any that are diseased or otherwise defective. A light shake of the riddle causes everything under the size of the mesh to pass on to the under sieve, the balance remaining on top being immediately ready for bagging or boxing.

It is advisable to have a range of these riddles from 1¼ inch mesh rising by ¼-inch gradations to, say, 2 inches, in order that the grower may have the choice of sizes to suit the grades intended to be made. No definite size of mesh to be used can be given, as the different varieties, on account of their varying shapes, require different-sized meshes.

One feature of these riddles is that they are inexpensive, and with ordinary care, will give many years of service. The potato screen may be used to replace the large diameter, small-mesh riddle.

Where grading is done at harvesting, considerable annoyance and trouble often are experienced, particularly where a number of pickers are employed, as consignments may be rejected at the loading station through careless grading on the part of only one of the pickers. Should the Inspector happen on a bag or two of this low-grade stuff, the whole consignment may be condemned, and has to be graded over again before securing a certificate.

Sorting over the whole truck-load often may be obviated by allotting to each picker a distinguishing mark or number, and having his particular bags branded with such mark or number. When trouble arises at inspection, it can be ascertained whether one or all of the pickers are at fault. If only one is at fault, the expense of sorting over the lot is eliminated and confined to only those bags bearing the brand of the faulty grader.

The mechanical grader may be operated either by hand or small engine. This machine is of particular value in expediting the grading where there is not much disease affecting the crop. It is adjustable to practically any grades, and will sort three sizes at one operation. The chats are delivered into bags on the side towards the rear of the grader, the middle sizes at the side towards the front and the prime tubers over the front. This grader is of comparatively light weight, and may be moved for short distances by hand.

The grading of potatoes for market is an operation which should be conscientiously carried out. The neglect to grade well, or the attempt to palm off inferior stuff, is certain to prove unprofitable, for the simple reason that merchants, once bitten, will steer clear of such growers in future purchases. Growers should aim at sending their potatoes to market in such condition that they would be prepared, and pleased, publicly to claim ownership.

## Field Crop Competitions

In order to foster the potato-growing industry in their respective districts, several agricultural societies in this State have for some years offered prizes for competition amongst their growers for the best crops of the season. These examples might be followed with profitable results by the societies of other districts. Such competitions cannot but have an all-round beneficial influence. The friendly rivalry created by them must of necessity promote effort to increase knowledge of how soils can best be husbanded to increase their productiveness, and how crops can

best be treated so that their prolificacy may be augmented. The acquirement of that knowledge, coupled with the desire to eclipse the results obtained by other growers, must develop interest which will find expression in its practical application to the cultivation of crops, with the necessary result that higher all-round yields will obtain.

It may be argued that the growing of a few acres for a competition would not affect the standard of cultivation of the larger areas generally grown commercially. A moment's consideration should be sufficient to prove the fallacy of such argument. The educational benefit derived from the practical demonstration of the increased yield from the small area on which more intense cultural methods were practised, would make it obvious that these methods produce returns showing a greater proportionate profit, and would have the effect of causing these improved methods to be applied to the larger areas.

During the past few years, observation of many of the crops entered in field crop competitions have shown that considerable improvement in the quality and tonnage of the crops could be accomplished by closer planting of the seed. Many of the crops yielded weights of from 12 to 18 tons per acre. In one exceptional case, a yield of over 25 tons of marketable tubers was recorded. This is believed to constitute a record for Victoria, if not for Australia. The credit of growing such heavy tonnage was in many cases marred by the fact that the tubers produced were coarse in size and quality. This could be remedied if growers adopted the practice of closer planting of the seed than is the rule.

Land which is capable of growing 15 to 18 tons of potatoes to the acre, is rich enough to carry a full crop with planting distanced 2 ft. 3 in. between the rows, and the sets spaced 14 inches or 15 inches in the rows. Planting at those distances, or even less on the richer lands, would have the effect of producing heavier yields of medium-sized and better quality tubers. The grower who produces tubers as large as mangolds has his system of planting to blame. He should plant closer, and so restrict the feeding area of the plants. The result would be improvement in size, improvement in quality, and equally heavy, if not heavier, tonnage per acre.

## No. 10. Diseases and Pests

The main sources of damage to the potato crop are fungus and bacterial diseases and insect pests. In order that growers may be able to identify these and know how to combat them, a brief description of the more common diseases and pests is appended.

As a general means of disease control, apart from chemical or other treatments, careful attention should be given to the selection of seed from

prolific and healthy plants, the greening of the seed by proper storage methods, rotational cropping, and clean cultivation.

### Rhizoctonia solani (Collar Stem Rot)

*Rhizoctonia* or collar stem rot is one of the most common causes of damage to the crop, and affects the plants in a number of ways. If this fungus attacks the plant severely enough in the early stages of growth, it will completely kill the plant before any tuber formation has taken place. This is the most severe form of disease. When the disease develops at a later stage of growth, examinations of the plants at the ground surface line will show discoloration and partial rotting of the stems at that point (hence the common name, collar stem rot). This rotting interferes with the normal development of the tubers and has the effect of producing an abnormal growth of the top, with the formation occasionally of aerial tubers in the axils of the leaves and the production of a great number of small and useless tubers underneath the stalk.

Another effect of the disease is the formation on the surface of the tubers of scab, which, while not seriously affecting the potatoes, so far as their use for consumption is concerned, detracts considerably from their value because of the unsightliness of the scab and the wastage of the damaged portion.

A further symptom of *Rhizoctonia* is the splitting of the tubers as though they had been slashed with a hoe or a knife while growing, but this form of damage is not common as the scabbing.

*Control Measure.*—Although this disease is very prevalent and causes considerable damage, it can be largely controlled at comparatively small cost. The control recommended is the dipping of all potatoes intended for use as seed in a solution of formalin. For potatoes that have not sprouted, the solution should consist of 1 lb. formalin to 20 gallons of water; the required period of immersion is 1½ hours. When dipping is deferred till the potatoes have sprouted, the strength of the solutions should be reduced to 1 lb. to 30 gallons, as the higher strength burns the sprouts, and although these will come again they will not be so strong as the first sprouting. In potato-growing, it is important wherever possible not to impair the first sprouts. Corrosive sublimate at the strength of 1 in 1,000 is an effective dip, but is not recommended on account of its poisonous nature. Its danger in this direction lies in the fact that it is practically odourless, colourless and tasteless. Whenever dipping is done, care should be taken to have the treated potatoes properly drained after being taken from the solution.

### Phytophthora infestans (Irish Blight)

Though capable, under certain conditions, of reducing a crop of potatoes in a very short space of time to a useless putrid mass, this

fungus is not the serious menace in Victoria which it was once believed to be. In the history of potato-growing in this State, there has been only one outbreak of magnitude, *viz.*, that in the season 1910–11, when the damage was extensive. It has been estimated that the injury done in that year by blight was anything up to 75 per cent. or 80 per cent. of the crop. The disease is, of course, to be found every year in some corner or other, but the normal weather conditions in the average growing period of the crop in Victoria are against its development in epidemic form. The fungus thrives best at moderate temperatures with high humidity. One of the best protections against blight in Victoria is the high temperatures and dry hot winds which generally prevail when the plants are at the most susceptible stage of their growth, *viz.*, at flowering time.

The earlier symptoms of the disease are discolorations and breaking down of the leaf structure accompanied by mould on the under side of the leaf. Close, muggy weather favours its rapid development, and then the whole of the tops of the plants quickly collapse, and the spores are carried from these down to the tubers. An advanced stage of disease is always once experienced, can never be mistaken.

*Control Measures.*—Dipping seed in formalin as for *Rhizoctonia* has a controlling effect, although it only reaches the disease on the surface of the tubers. Heating seed to a temperature of about 105°F. for four hours kills the disease, but this method is not practicable on most farms. Spraying is the only feasible method of control, but it is costly, and in face of the fact already stated, that the disease is of rare occurrence in epidemic form, spraying systematically each season is not justified from an economic point of view. In other words, regarding the experience of Irish blight damage over a long number of years in Victoria, it pays growers to take the risk of not spraying rather than to adopt an expensive, regular course of spraying each season. Should spraying be decided on, the materials recommended are copper sulphate and washing soda—8 lbs. copper sulphate and 10 lbs. washing soda to 40 gallons of water. To get a proper solution, it is necessary to dissolve the copper sulphate first; this will be facilitated if the ground form is used with hot water, as the crystal form is slow to dissolve. The washing soda should then be dissolved and added to the copper solution, and the mixture is then ready. It is essential that it be kept constantly agitated when in use.

The spraying of the crop certainly may be justified where special lots of seed are being grown, but it should be noted that this treatment is purely *preventive* and not *curative*. This applies to all disease controls. For that reason, spraying must always be done prior to the disease making its appearance.

### Alternaria solani (Early Blight)

The common name of this fungus disease is given, because it generally makes its appearance in the leaves of the crop as soon as the young tubers commence to form. It does no damage to the tubers themselves, though in certain seasons it reduces the yield considerably owing to the damaged leaves being unable to function fully. The disease is easily recognized by the spotting of the leaves.

*Control.*—The best control is selection of seed from sound, good bearing plants, as the trouble makes headway on plants of low vigour.

### Scab (Various)

Scab on potatoes may be due to quite a number of causes, such as fungus pests, bacteria, mechanical injury from any cause, the larvæ of insects, or the insects themselves. *Rhizoctonia* as a cause of this blemish has already been dealt with.

### Oospora scabies (Common Scab)

This scab-producing fungus is not so common as *Rhizoctonia*, but does quite considerable damage annually. The damage done is confined to the tubers.

*Control.*—Formalin treatment, 1 lb. to 20 gallons, for 1½ hours as for *Rhizoctonia*, is recommended as a control.

### Spondylocladium atrovirens (Dry Scab or Silver Scurf)

A scab-producing fungus of minor importance. It is best to guard against it by using clean seed. Probably, the formalin treatment would tend to control it.

### Synchytrium endobioticum (Black Scab or Wart)

A virulent fungus disease not present in Victoria, but which causes extensive damage in Great Britain and Europe. So serious is it regarded there that a notification of its appearance must be made to the authorities. No control has been found for it. Fortunately, certain varieties in these countries seem to be immune from its attack.

### Spongospora subterranea (Corky or Powdery Scab)

This fungus affects the tubers only by causing what is commonly termed a scab on the surface. To a certain degree, it is controllable by the formalin treatment, but is practically impossible of eradication. The disease can be carried over from season to season either on the tubers or in the soil. Happily, it is not known to be in Victoria at present.

According to authorities, this fungus does most damage to crops grown in districts with high rainfalls, and as this condition applies to a very big percentage of the Victorian potato-growing country, the disease must be regarded as a dangerous one.

### Fusarium solani (Brown Ring)

This disease is recognizable on cutting the affected tubers, for the so-called brown ring is then shown. It may appear only at the heel end of the tubers, but, in severe cases, will show in any cross-section. An early symptom of the disease is the wilting and drying off of the foliage.

*Control.*—Selection of clean seed and use of the formalin treatment.

### Brown Fleck or Sprain

The cause of brown fleck is unknown. It affects only the inside of the tuber, the outside of which remains apparently perfectly clean and free from blemish. If an affected tuber be cut, brown specks or flecks will be found dotted through and disfiguring it. It is believed by some authorities to be caused by extreme variations in weather during the growing period, and to be therefore purely physiological.

### Bacteriosis, Wet Rot (Bacillus solanacearum)

This bacterial trouble, which is variously known (in different districts) by the common names of wet rot, sore eye, and Jammy eye, is common to most parts of Victoria, but is most damaging on low-lying country. The first symptoms are a sudden limpness of the tops as though they had collapsed under extreme heat. Discoloration of the leaves follows, first to yellow, then to brown, and finally the tops of affected plants shrivel up. The stems become streaky as the disease travels downwards and ultimately affects the tubers. The first symptom on the tubers is a discharge from the eyes. Finally, the whole tuber becomes a dirty slimy mass.

Though a large percentage of a crop may be affected, the disease does not take the crop on a face, as is the case with a severe attack of Irish Blight. Sound plants can always be found alongside and amongst those affected.

*Control.*—Use only seed from free areas. Clean cultivation and thorough intercultivation, especially during dry weather.

No chemical treatment can be recommended for the control of bacterial diseases.

### Black Leg (Bacillus phytophthorus)

Though widespread in its occurrence, black leg does not do extensive damage. As in the case of wet rot, it is spread chiefly by the use of infected seed, so that an obvious control is seed from a crop free from the trouble.

For the lessening of many diseases, and this applies particularly to bacterial diseases, the proper storage of seed, so that it may be

thoroughly greened, is a considerable check. Not only does the greening arrest the trouble to some extent, but the fact that properly stored seed can be planted without the sprouts being broken enables the grower to discriminate between strong-budded, vigorous seed and that of a weak character, due to disease or degeneration, or both. If inferior seed be discarded, the ensuing crop will at least have the chance of starting the season with full vigour.

*Control.*—Selection of seed and proper storage. An affected plant rarely produces anything but a few small tubers, so that seed selection would largely eliminate affected seed.

### Thready Eye or Spindle Disease

Although attributed to various sources, the cause of this trouble is not positively known. Certain soils, chiefly those poorly drained, produce tubers which, though apparently perfectly sound, show, when they are sprouted, great weakness in the buds. These sprouts, in fact, are so puny and thin that they suggest the common titles of thready eye or spindle growth.

*Control.*—No chemical control can be given. The only treatment suggested is correct storage, so that the affected seed may be discarded when planting is being done.

### Potato Grub (Lita solanella)

Potato-growers throughout the Commonwealth have for many years suffered very heavy losses from the damage done by the grub of the potato tuber moth. The actual damage is effected by the larvæ of the moth attacking the tubers by penetrating the skin and tunnelling their way through the flesh thereby rendering the potatoes unfit for consumption, and where the injury is severe, unfit for seed. The tubers may be damaged either before or after harvest.

The moth is particularly active in hot, dry seasons; in wet seasons, no trouble is occasioned.

A most prolific breeder, under favourable weather conditions, it is capable of increasing to vast numbers in a very short period. A practical demonstration of this is the experience of the present season (1933–34), which has been warmer than usual, with the result that the activities of the moth and grub have amounted in certain districts to almost a plague.

*Control.*—Many efforts have been made to combat the ravages of this pest. Spraying the crop with solutions for poisoning either the moth or the grub is neither practical nor economical.

It has been demonstrated that by keeping the soil in which crops are grown well tilled, so that a fine mulch can be moulded over the

tubers, the grub can be prevented from getting access to them. Where cultivation is poor, the tubers in any soil are placed directly at the mercy of the grub.

Loose, sandy soils give the best protection, but unless this class of soil is kept well moulded over the rows of the crop, it is liable to be washed down by rains, or blown down by the wind, to such a degree that the tubers nearest the surface are exposed to the air and the grub. Soils of a loamy or clayey character, if not well cultivated, are liable to become baked or caked on the surface by the action of rain. Subsequent drying by the sun tends to crack the surface, making tiny fissures by way of which the grub can reach the tubers.

Good cultivation and tilling are a great protection to the crop from grub damage, but the limit of this method of protection is reached when harvesting commences. Immediately, the tubers are exposed, either by hand or mechanical digger, the moth, in seasons favourable to it, lays its eggs on the tubers. Within a few days the eggs are hatched, and the larvæ actively engaged in the potatoes. Growers are only too well aware of the rapidity and extensiveness of the work of this grub, and will agree that bagging and removal can hardly be done quickly enough to beat the attack of the moth.

In 1922, the Department made a number of tests with various preparations to prevent grub damage, and the only one found to be effective was the tuberol treatment. Tuberol is an emulsified oil compound. If the potatoes are treated prior to infestation by the grub, spraying with a solution of tuberol at the strength of 1 gallon to 30 gallons of water will suffice to prevent damage. If the grub is already in the tubers, it is necessary to dip them in tuberol solution of the same strength for a period of at least half an hour. Potatoes for consumption may be treated without detriment as well as those intended for seed.

### Eelworm (Heterodera radicola)

In certain districts in the State, these nematodes cause a considerable amount of damage. They are found on crops in all classes of soil, whether virgin or otherwise, but the most favourable conditions to them are found on well-drained lands. The damage to a crop is caused by the female, which is scarcely visible to the naked eye.

Affected tubers are easily detected by the cysts formed, generally in clusters, on the skin of the tubers. These cysts break down later, and form a scab which, without microscopic examination, is not readily distinguishable from other causative agents of scab.

*Control.*—As control of damage by chemical treatment is not economically practicable, the only recommendation that can be made is to use eelworm-free seed as far as possible. Rotation of crops is also

advisable, so that potatoes will not be planted in the same soil oftener than once in four or five years. The reason for the effectiveness of rotational practice is that the eelworm changes its host plant only with difficulty, and when rotation is practised, the worms are starved out in large numbers before they can adapt themselves to a new plant.

Heavy applications of potassium sulphate to the crop have been found to have a checking influence on eelworm damage, but as potash has a distinctly depressing effect on potato yield in practically all Victorian soils this treatment cannot be advocated. In any case, the very high cost per acre of such applications puts the potash treatment out of court.

In districts where eelworm infestation is found, it is inadvisable to follow a grass and clover crop with potatoes, as this practice is favourable to eelworm. The safest crop to precede potatoes in affected country is an oat or barley crop. Preferably, these should be fed off by stock, and the final growth ploughed in either before planting the potatoes, or at the actual planting time. This method gives the greatest degree of immunity from eelworm.

### Rutherglen Bug (Nysius vinitor)

Occasionally, the Rutherglen Bug has caused considerable loss to potato-growers, though in the majority of seasons it is not much in evidence. It is a suctorial insect which attacks the leaves of the growing crop. Some years ago, the bugs appeared in myriads in Gippsland; they destroyed some crops completely, and greatly reduced the yield of others by damaging the leaves.

*Control.*—Smudge fires placed at short intervals through the crop are an effective check. These fires are made from any old rubbish, such as waste straw, cavings, and bagging, and a couple of handfuls of sulphur should be added to each. This treatment is effective in driving off the insects and generally prevents, because of the residual odour of the sulphur, a recurrence of the attack.

### Degenerative Disease (Virus)

Becoming each year more in evidence, virus infection of the potato crop is a very serious cause of reduction in yields. Though its actual cause is not definitely known, it is generally admitted that once a parcel becomes affected there is no known means of eradicating the disease. It is spread from diseased plants to clean ones by green aphis, and is fairly easily recognizable by one of three variations in the manner in which its presence is revealed on the tops of the plants. It is not recognizable on the tubers, though these may act as carriers. The result of the disease is a lessening of the yield of the crop; in severe cases, the loss may amount as much as 80 per cent., perhaps more.

*Control.*—Unfortunately, this disease cannot be controlled by chemical treatment, as can *Rhizoctonia,* etc. The only possible safeguard is the practice of seed selection, *i.e.,* the selection only of tubers from plants, apparently free from disease, of good type and high productive capacity. Even then, an absolute guarantee from virus infection cannot be given, but the grower who chooses his seed in the way mentioned is at least giving himself the greatest chance of having a clean crop. It has been noted that the use of immature, instead of ripe seed, secures a degree of immunity from virus attack. Greening of seed during storage and the consequent preservation of the buds is also of considerable advantage, because this enables the grower to discriminate between vigorous and weakling tubers, and virus is always associated with weakened constitution.

### Result on Yield of Disease Control

As showing the advantage to be gained by preventing disease damage to the crop, the following figures obtained at the Millbrook Experimental Station are submitted. For three seasons, a portion of the seed used was treated with formalin at the regular strength (1 lb. to 20 gallons of water), while as a check the remainder was left untreated.

The diseases which it was desired to check were chiefly *Rhizoctonia* and ordinary scabs.

The following were the results:—

| | *T. C. Q.* | |
|---|---|---|
| Average for three years from dipped seed .. | 6–3–0 | |
| Average for three years from undipped seed | 3–2–0 | |
| Increased average yield for three years .. | 3–1–0 | or 98% |

No claim whatever of any manurial value is made for the formalin. The increase (which is of extraordinary significance) was entirely due to the fact that the plants, being freed from attack by these particularly prevalent diseases, were able to function normally without restriction, and so develop the tubers to the full.

—*The Journal of the Department of Agriculture, Victoria, Australia,* Vol. XXXII, Parts 4 and 5.

196-37—Printed at The Bangalore Press, Mysore Road, Bangalore City
by G. Srinivasa Rao, Superintendent.

# THE JOURNAL OF THE MYSORE AGRICULTURAL AND EXPERIMENTAL UNION

A quarterly magazine devoted to the advancement of Agriculture and published by the Mysore Agricultural and Experimental Union


**BOARD OF EDITORS**

**Chairman:**

B. Narasimha Iyengar, B.A., Ph.D., Director of Agriculture in Mysore

**Chief Editor:**

Venkata Rao K. Badami, L.Ag., Ph.D. (Cantab.), Deputy Director of Agriculture

**Associate Editors:**

M. J. Narasimhan, B.A., Mycologist

M. G. Singarachar, B.A., A.C.E., Agricultural Engineer

N. Krishna Iyengar, B.A., Inamdar, Uragahally Estate

D. G. Ramachandra Rao, Assistant Director of Agriculture (*Retd.*)

H. Srinivasa Rao, Retired Deputy Conservator of Forests

T. V. Subramania Iyer, Dip.Agri., Entomologist

B. Venkatanarnappa, M.A., Professor of Physics (*Retd.*)

K. Bhima Rao, B.A., Agricultural Chemist, Editor, Kannada Edition of the Journal

Lieut. A. A. Monteiro, G.B.V.C., Live-Stock Expert

K. Krishna Iyengar, G.B.V.C., Superintendent, Civil Veterinary Department

**Secretary:**

M. Vasudeva Murthy, B.Ag., Agricultural Inspector



*Rates of Subscription :—*

Free to members of the Union

Rupees 3–5–0 per volume to non-members

Foreign subscription, 5 shillings

Subscription can begin from any number desired

Single copy, annas 13. Foreign, 1*s.* 3*d.*

Inclusive of postage in each case

*Rates of Advertisement :—*

| | Single Insertion | Annual (4 consecutive numbers) | |
|---|---|---|---|
| Full page Royal Octavo | ... Rs. 15 | Rs. 45 | Payable in advance |
| Half page | ... Rs. 8 | Rs. 25 | |

All communications regarding advertisements in the Journal should be addressed to Mr. M. S. Gopalan, Advertising Consultant, Malleswaram Post, Bangalore, and the rest to the Secretary, The Mysore Agricultural and Experimental Union, Seshadri Road, Bangalore.